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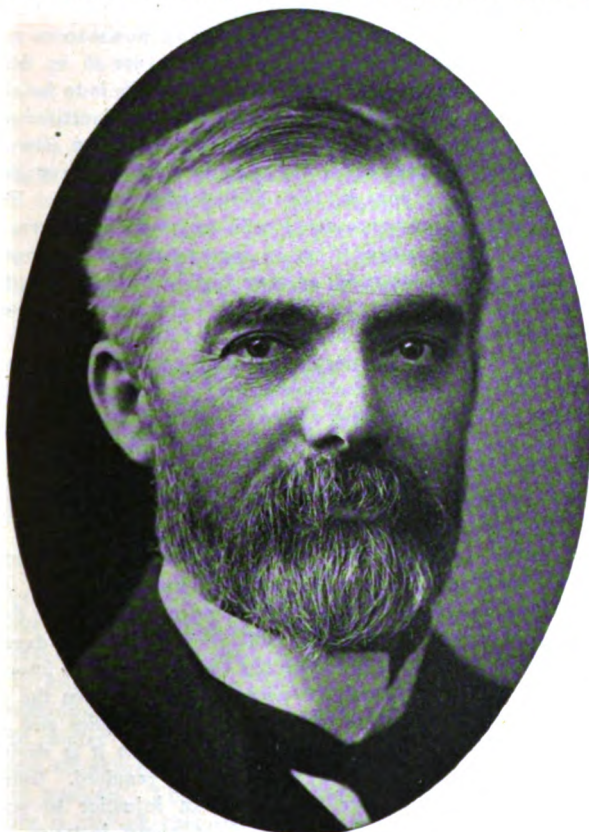
CLEVELAND, NOVEMBER 30, 1905.

No. 22.

**TOLEDO SHIP BUILDING CO. FORMED
The Craig Yard at Toledo Unconditionally Sold to Interests Formerly Connected with the Detroit Ship Building Company.**

The plant of the Craig Ship Building Co. at Toledo has been purchased outright by a new company organized by Alexander McVittie, C. B. Calder and Frank E. Kirby of Detroit and L. C. Smith and H. S. Wilkinson of Syracuse,

der its general superintendent and Mr. Frank E. Kirby its consulting engineer. The Detroit Ship Building Co. is a part of the American Ship Building Co. The organization of the new company and the arrangements for pur-



MR. ALEXANDER MCVITTIE.

N. Y., and known as the Toledo Ship Building Co. The actual sum paid for the Craig plant is not given out, but the new company was incorporated with a capital stock of \$1,100,000. The Craigs retire altogether from the company. The persons associated with the new company are, of course, well known. Mr. Alexander McVittie was the president of the Detroit Ship Building Co., Mr. C. B. Cal-



MR. C. B. CALDER.

chasing the Craig plant appear to have been conducted with the utmost secrecy, for Mr. James C. Wallace, president of the American Ship Building Co., says that he knew nothing at all about it until the resignation of Messrs. McVittie and Calder were received on Tuesday of last week. It had been known, however, for some months that the Craig plant was for sale. Messrs. L. C. Smith and H. S. Wilkinson are the principal stockholders in the United States Transportation Co., which operates a large fleet of

vessels on the lakes and which gave an order just a few weeks ago to the American Ship Building Co. for a new 10,000-ton freighter to come out during 1906. It could not be learned in what manner the stock had been apportioned, but it is the general understanding that Mr. Smith and Mr. Wilkinson have furnished most of the money.

The Toledo Ship Building Co. will take immediate charge of the Craig yard and the new company will be



MR. FRANK E. KIRBY.

organized with the following officers: Alexander McVittie, president; L. C. Smith, vice president and treasurer; H. S. Wilkinson, secretary; C. B. Calder, general manager; Frank E. Kirby, consulting engineer. It is the intention of the new company to largely develop the capacity of the Craig plant, though the Craigs have during the past two years spent considerable money in reconstructing their yard which is really a well-planned and excellent one for its size. The Craig yard at present has two building berths and a dry dock 525 ft. over all, 500 ft. on the keel blocks and 57 ft. gate width. The largest vessel that it has ever built was the steamer James P. Walsh, 505 ft. over all, launched last summer. It has a duplicate of this vessel now on the stocks and an order for a small passenger boat. It is understood that another dry dock 650 ft. long will be constructed, ample enough to accommodate any vessel now afloat on the lakes, and that a sum, equal to the purchase price, will be spent for new equipment.

Anyone familiar with the personnel of the new company will realize at once its shipbuilding ability, especially in the construction of passenger steamers, and it is understood that the construction of this type of vessel will be a feature of the yard. Mr. Frank E. Kirby, consulting engineer, has a national reputation as a designer of passenger boats. He has designed the leading passenger boats on the lakes, notably the Eastern States and Western States of the Detroit & Buffalo line, and was lately engaged to design a new steamer for the Detroit & Cleveland line. He has not been connected with the American Ship Building Co. for some time past and a few months ago announced his intention of removing to New York to engage in business as a naval architect.

Mr. C. B. Calder was formerly a resident of Cleveland and was the chief engineer for M. A. Hanna & Co. He resigned this position to become superintendent of the engine works of the old Detroit Dry Dock Co. Six years ago he entered the employ of the Detroit Ship Building Co. at Wyandotte.

Mr. McVittie has been at the head of the Detroit Ship Building Co. for a number of years and is a man of recognized ability in executive and financial management. Mr. Wm. G. Henderson, formerly of the Detroit Machine Shop and Mr. Howard I. Sheperd have resigned to engage with the new company.

In an interview given out in Detroit Mr. Calder credits Mr. Lyman C. Smith with having originated the idea of the purchase of the Craig plant. Mr. Smith owns the controlling interest in the Smith Premier Typewriter Co. and with Mr. H. S. Wilkinson controls the United States Transportation Co., which operates a fleet of fourteen vessels on the lakes. He believes that the commerce of the lakes is growing with such bounds as to justify additional ship building capacity and has gone into the venture merely as an investment.

The Detroit Ship Building Co., owing to its peculiar organization and character of work, was the most independent shipyard in the combination controlled by the American Ship Building Co. Mr. James C. Wallace, president of the American Ship Building Co., has not selected successors to Messrs. McVittie and Calder and does not expect to during the present week.

BIDS FOR NAVY YARD SUPPLIES.

Washington, Nov. 26.—As the result of a decision just reached—and in accord with the general policy of economy which now characterizes almost all branches of the United States government the navy department will not in future advertise generally for bids for furnishing supplies and equipment for the various U. S. navy yards, as has been the practice for years past. It has been decided to limit in future published calls for proposals to those city newspapers published nearest the yards where the supplies are to be delivered. Thus when machine tools or steel in bulk is to be purchased for use at the Brooklyn navy yard the advertisements will appear only in the New York city or Brooklyn newspapers, whereas purchases for the League Island navy yard will be announced only in the Philadelphia dailies. This plan of making announcements will, in many instances, be virtually valueless, however, in so far as prospective or possible bidders are concerned, as may readily be appreciated if one will stop to consider the effect of this new policy in instances where purchases are to be made for the navy yards at Pensacola, Florida, Bremerton, Wash., and other comparatively isolated points, the newspapers of which cannot be expected to have anything approaching a national circulation. Moreover in the case of contracts for material or equipment for Pacific coast navy yards where the copy for advertisements must be sent from Washington to the Pacific coast newspapers, and issues of the latter containing the advertisements transmitted back east ere the eastern manufacturers are apprised of the needs of the department, a delay of ten days or more being thereby entailed will allow firms who depend upon such sources of information but the most limited interval of time in which to secure the necessary blanks from the department and return same to the bureau of supplies and accounts duly filled out with the proposals which it is desired to submit and accompanied by guarantee as required. Indeed such a plan of procedure will work an injustice to some bidders unless proposals are invited in every instance one month or more in advance of the opening of bids. Under the new system manufacturing and supply firms which do not care to incur the virtually needless expense of retaining an attorney to represent them personally before the purchasing bureaus of the departments will be virtually dependent upon the trade press and particularly the *Review* to apprise them of pending competitive biddings.

Speaking of the representation of business firms before

departments which are engaged in purchasing supplies of various kinds it may be mentioned that this class of business is just now being most energetically sought by a large number of more or less legitimate "attorneys" resident at Washington some of whom it is charged are overstepping the bounds of propriety in their campaigns for clients. In some instances the "business lobbyist" merely offers his services for the submission of bids etc.—something that can be done just as well by mail—but in some cases manufacturers are approached with offers to have their particular products specified by the government officials in calling for bids in the respective classes involved and a few particularly bold individuals have, of late, it seems, approached manufacturers whose goods have long been specified (through no efforts of their own) in government specifications and have, it is said, intimated that unless a retainer was forthcoming such designations would be discontinued.

Among the proposals opened at the bureau of supplies and accounts of the navy department on Nov. 14 were bids for one magnetic metal separator and dynamo for the League Island, Pa. navy yard. The proposals were as follows:

Drew Machinery Agency, Manchester, N. H.	\$172 and \$150
J. S. McCormick Company, Pittsburg, Pa.	\$225
Manning, Maxwell & Moore, New York City	325
S. Obermayer Co., Cincinnati, Ohio	300

For furnishing one 3-inch hollow turret lathe for the League Island yard the only proposal submitted was that of Manning, Maxwell & Moore who offer to fulfil requirements for \$4,650.

For one open side planer for the League Island yard two bids were submitted—the Detrick & Harvey Machine Company of Baltimore, Md., \$9,215 and Manning, Maxwell & Moore of New York City, \$9,165.

The contract for ammunition hoists for which the Ordnance Bureau of the War Department opened bids on November 3, went to Dietrich Brothers. Theirs was the second lowest bid but promise of quicker delivery won them the contract. The Ordnance Office will on Dec. 7 open bids for fifty 2½-inch Lyle life-saving guns.

Eight portable rivet forges for boiler makers will in the near future be purchased by the Isthmian Canal Commission. The fan is to be driven with gears all enclosed in a case. A forge with blower driven with levers, ratchets, straps etc. is not wanted. The basin should be about 18 in. diameter and 5 in. high.

BATTLESHIP BROKE THE RECORD.

The new battleship Virginia, a product of the Newport News Shipbuilding & Dry Dock Co., in her screw standardizing tests Nov. 21, made one dash over the measured mile off Owl's Head at the speed of 19.74 knots an hour, a new American mile record for ships of her class and .31 parts of a knot faster than that made by the Rhode Island three weeks ago. The spurt was made on the third of the 11 runs, during which it was ascertained that 129.3 revolutions of her screws are necessary for the Virginia to maintain her contract speed of 19 knots per hour. The Rhode Island required 125.3 revolutions to maintain the same speed. The trial was made under favorable conditions, there being a fairly strong off-shore breeze, which made the course comparatively smooth. The battleship left the harbor shortly before 9 o'clock this morning, and after the warming up run up the bay, came back and headed for the mile with her smokestacks belching great clouds of smoke and the water tumbling in huge cataracts over her bows. The average for five best runs over the course, was 18.975 knots an hour. The machinery worked perfectly, and there was very little vibration at high speed. The star-board engine averaged 129.32 revolutions, and the port

129.22 revolutions, while the vessel was making her 19 knots. In addition to the trial board, headed by Capt. J. H. Payton, there was on board Capt. Seaton Schroeder, who will command the Virginia after she goes into commission.

BUFFALO SITUATION.

Buffalo, Nov. 28.—The word is going out that next season is to be a good one for the lake trade and that in spite of the certain falling off in lumber and the steady gain of the all-rail routes on the lake fleet out of Chicago. It is true that there have been special reasons of late for the loss of lake business from southern Lake Michigan ports and these may disappear next season. It sounds like a contradiction, but it is a fact that the Chicago-Buffalo route by lake has lost to the all-rail lines very materially this season through car shortage.

Never has the grain come in from the west by rail as now and never has the car famine been so pronounced and far reaching. The roads were wise enough to take advantage of this by sending their cars well into the west early for the much-coveted long haul, for which they will sacrifice all way or local business. Shippers were aware of this diversion long ago and were grimly sorry when quite an amount of these cars did not come back at all. They tell us of one road in particular which is today fairly crippled because its cars were allowed to slip away westward and have done service all the fall hauling sugar beets in Michigan or serving as storehouses on local western roads elsewhere at 25 cents a day.

We hear that Chicago is making some effort to become an all-round lake port again, but it has an up-hill task before it, if only because it is not the source of either ore or lumber and must divide at a losing figure the traffic in grain and flour with Duluth, which has no rail competition to waste its lake freight while the lakes are idle. Neither can Chicago hope to contribute to the new Buffalo idea of becoming a great winter port for wheat. This ambition has been long developing here, but is now to be realized. The argument was always with us, but it takes something more than argument to control business.

It was said that Buffalo was the port farthest east that was entirely safe as a great grain depot and yet year after year the elevators gave up their grain at the end of the lake season as a skimmer does water and stood empty all winter and Buffalo remained a mere passing point for grain, lacking a principal feature in the race for such business while at the same time being especially well adapted to it. Now the port is favored by circumstances again and the grain flows in to remain for the winter. All the elevators had full complements of winter-storage grain long ago and still it is taken to be held here.

It takes an immense amount of room to do a transfer and a storage business in grain, especially as the plan is to preserve the identity of the cargoes. People who figure merely from measured capacity wonder why it is possible to take care of so little grain in the elevators here. Even the western elevator showings are very misleading, for it is impossible to provide individual bins for car grain, except for immediate transfer. So the last resort is to lay up the grain afloat, and this is being done. Even local millers are obliged to do this, sometimes much to their discomfort. Last winter, for instance, some of the mills stood still awhile because of grain cargoes frozen in at remote places in the harbor after the usual time for harbor opening.

Vessel agents are estimating that there will be possibly 15,000,000 bushels of grain, mostly wheat, with a large amount of flaxseed, laid up here this winter and give as

reason for the estimate a report that a single house in Duluth has chartered 5,000,000 bushels of room for that sort of storage. It may turn out that the old idea of building elevators for winter grain, with an incidental provision for handling through the active season is also out of date. When it is noted that some winters not so far away there have been only two or three cargoes held here afloat the change of front is remarkable.

Still this does not make it pleasant to see all summer more grain going through here by rail than by lake, so we are in great impatience for the completion of the barge canal, which may be, and seems likely to be, the only chance of retaining the lake grain traffic from Lake Michigan that seems to be slipping away. The canal closes now with a miniature fleet, but which has been earning so much lately at 5 cents on wheat to New York that it is said that a fairly large number of boats will be built for next season. Surely a boat that is able to gross 10 percent of her value on a single trip of 500 miles is good property, better, in fact, than the average of lake craft, much as some of the lake fleet has been making of late.

They say that all the lay-up room in the harbor has been taken. There is no need of offering room free. The fleet that must winter here, either on account of winter cargoes or from getting in late is too large for any docks to go begging.

JOHN CHAMBERLIN.

JAS. J. HILL'S SEATTLE TERMINALS.

In steamship operations as in the management of his railroad system, James J. Hill, president of the Great Northern, is not a man to do things by halves, or to run his business on a small scale—when a larger one suits his purposes better. Some writers have designated him as

ferred rapidly from cars to vessel and from steamer to train, without any trucking or draying being required for any through cargoes.

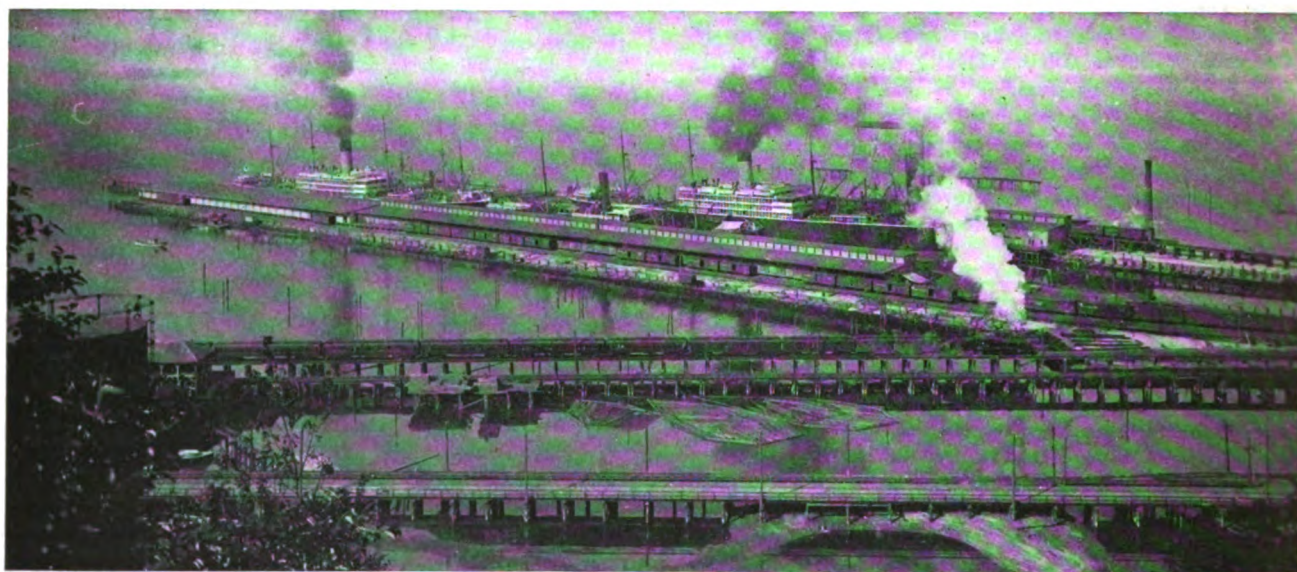
In this, Hill has shown his usual business sagacity, for, under the existing conditions, the enormous freight bulk—bound eastward, or across the Pacific—is quickly and economically handled. Time and expenses are always two very important factors in the eye of Jim Hill.

Every appliance connected with the handling of freight is very complete, and the immense capacity affords opportunity for facilitating the rapid disposing of cargoes and train loads. A great shed covers the pier for its entire length so that freight at all times and in all kinds of weather, is afforded ample protection.

The photograph not only gives a splendid view of the pier and its watery environments, but shows also the two huge "Marine Sisters" lying alongside. Usually, these liners are never in the same port at once. However, on this occasion, one of the vessels was unavoidably detained at Seattle, and before sailing for the Orient, the other "big Baby Sister" came steaming into port. In that way, the photographer was lucky enough to get them both in the picture.

BALTIMORE AND OHIO IMPROVEMENTS.

The Baltimore & Ohio Railroad has just awarded contracts for improvement work as follows: To W. J. Marson & Co., Akron, Ohio, signal towers, coal and oil houses at Flushing Tunnel, Ravenna, Lowellville, Nova and Kent, Ohio. To J. J. Walsh & Son, of Baltimore, the construction of two signal towers at Washington, one for each part of the "Y" connection. These signal towers are to be two stories, the first built of brick and the second having



THE GREAT NORTHERN LINERS MINNESOTA AND DAKOTA AT DOCK AT SEATTLE.

"a man of magnitude." This may be seen from the way he is causing his two giant Oriental liners—Dakota and Minnesota—to be run, and in the matter of dockage, and facilities for handling the vast volume of freight, bound both ways of the compass. The home port of these huge steamers is Seattle, Wash., where direct connection is made with Hill's transcontinental railway system. Here the Great Northern Steamship Company have constructed a colossal dock along side of which the giant vessels lie when in port. This great dock extends straight out into Bay allowing vessels to moor on each side. This huge pier is 1,362 feet long, and nearly 200 feet in width. Tracks are laid for the entire length, so that freight may be trans-

copper facing, and they will be covered with tile roofs. The seven towers will cost about \$40,000. Holbert & Spedden, of Fairmount, W. Va., have been awarded a contract to erect a four-stall engine house and ash pit at Bridgeport, O., at a cost of about \$10,000. W. A. Liller, of Keyser, W. Va., will build a saw mill at Glenwood, Pa., that will cost about \$14,000. Niedermeier & Restle, of Youngstown, O., have the contract to construct a four-stall engine house, ash pit, coal tipple and turntable, all at Haselton, O., at a cost of about \$15,000.

The steamer Appomatox, wrecked on North Point, Lake Michigan, is practically broken up

FREIGHT SITUATION.

The season of 1905 on the great lakes is practically over. During the past week the wild ore rate has advanced to \$1 and \$1.05 from the head of the lakes, but the total amount of business transacted at this figure is but a small fraction of the ore movement. It does not appear that the Steel Corporation has at any time paid more than 75 cents. It has been practically out of the market all along for wild tonnage and has about moved all the ore that it wants to. The Steel Corporation has not announced its total movement, but it is probably in excess of 18,000,000 tons.

Notwithstanding the heavy movement of the year, it will be found that Lake Erie docks are in excellent shape. This has been due to the fact that probably 80 per cent of the ore was unloaded directly into cars and moved at once to the furnaces. Probably in no year has the ore made such a continuous stream from the mine to the furnaces with slight interruptions in the movement at receiving and shipping docks. It would not be surprising, if it could be got at, that a certain part of it actually never ceased its onward transit from the time that it left the mines. A portion of cars are, of course, dumped directly through the chutes into the vessels, and when this same ore is unloaded directly into cars, it makes practically a continuous movement.

The coal movement took a decided slump during the week, so much so that at some ports there was not sufficient coal on hand to fuel the vessels. The coal movement may really be said to be over, which is the reason that coal rates have remained steady for a week or more.

The general outlook for next season's business is extremely bright, and the railways are preparing to care for it by the construction of additional docks. It is also clear from the number of orders for new ships that have been placed for 1906 delivery that the shipowners do not intend to be caught napping.

NEW STEAMER FOR PICKANDS, MATHER & CO.

The American Ship Building Co. last week closed contract for its twenty-fourth freighter for 1906 delivery. The order was placed by Pickands, Mather & Co., of Cleveland. The new steamer will be 550 ft. over all, 530 ft. keel, 60 ft. beam and 31 ft. deep. She will have triple-expansion engines with cylinders 23½, 38 and 62 in. diameters by a stroke of 42 in. Her boilers will be 14½ ft. in diameter and 11½ ft. long, fitted with Ellis & Eaves draft. It will be noted that her beam equals that of the William G. Mather, which is the only ship on the lakes of 60 ft. beam. She is, however, 20 ft. longer than the Mather and will, therefore, be a greater carrier. Mr. W. I. Babcock, who was formerly connected with the Chicago Ship Building Co. will superintend the construction of the new steamer for her owners.

Of the twenty-four steamers for 1906 delivery, orders for which the American Ship building Co. has received during the present year, two of them, the John Stanton and the Joseph Butler Jr., have already been delivered.

PERSONAL.

Mr. Frank Jeffrey, superintendent of the Wyandotte and Bay City yards of the American Ship Building Co., has been appointed superintendent of the Detroit Ship Building Co. Mr. Jeffrey has been associated with interests allied to the American Ship Building Co. for the past twenty-two years. He was the superintendent of the yard at Lorain until the United States Ship Building Co. offered him the vice presidency of the Union Iron Works, San Francisco, which position he accepted. He returned to the lakes last July.

GREAT LAKES.

The Barnett & Record Co., of Duluth, are the successful bidders for the construction of the new No. 4 ore dock for the Duluth, Mesabi & Northern Railway. The contract involves an expenditure of about \$700,000 with \$300,000 additional, which will be expended by the railway company.

The local steamboat inspectors of Detroit, have suspended for nine months, the license of Capt. Charles Aber of the tug Fanny Tuthill, which was sunk six weeks ago by collision with the steamer D. C. Whitney, with a loss of one life. He is blamed for the collision.

The barge Harvey Bissell dragged her anchor while in shelter near Middle island last Friday and went on the rocks near False Presque Isle. The tug John Owen was sent to the wreck.

The steamer L. C. Smith, which was in collision with the steamer Simla at Marine City on Sunday, will make temporary repairs at Detroit. Three or four plates on the port side are broken and several frames damaged.

The schooner Checotah, which dragged her anchors and went on the beach under the east arm of the Cleveland breakwater, has about 5 ft. of water in her hold, but is not seriously damaged.

The steamer Joseph Butler Jr., left the Lorain yard of the American Ship Building Co. last Saturday on her maiden trip. Capt. Charles H. Hutchinson and Walter H. McGean went with her as far as Port Huron. The Butler will load wheat at Duluth for Buffalo.

The steamer George W. Perkins was loaded at the Northwestern ore dock on Friday last in less than three hours. Over 10,000 tons were put aboard.

ITEMS OF GENERAL INTEREST.

The city of Chattanooga contemplates purchasing the wharf now used by the Tennessee River Navigation Co. at a cost of \$50,000 to dedicate it in the future to public use.

The attempt to release the schooner Alta, wrecked some weeks ago on Grand island near Munising, has been abandoned by the Reid Wrecking Co., of Sarnia, which purchased the boat. The Alta will probably go to pieces.

Marine underwriters have decided to extend the insurance on steel vessels until Dec. 10. Under the policies the time expires Dec. 5. The insurance on wooden vessels is not extended. Of course, special rates are being paid for the extra time.

J. D. Wood, a tug master of Norfolk, Va., has signed a contract with the navy department to go to Manila on the floating dry dock Dewey. Mr. Wood is to live aboard the dock during the voyage.

The transport Solace is at Mare Island navy yard undergoing repairs. Her boilers are said to be in bad shape.

Senator Clark has completed plans for the establishment of a line of steamers, to be run from San Pedro to the orient in connection with the San Pedro, Los Angeles & Salt Lake R. R. These boats are to touch at the Hawaiian islands and the ports of Japan, China and Manila and are designed to compete with the steamers of the Hill lines, and to supplement the Harriman lines. The United States government has finished at San Pedro a breakwater costing \$5,000,000, which makes it a fine harbor, as vessels drawing 35 ft. can enter. The San Pedro line has begun the construction of large docks at its terminal, and the company is chartering tramp steamers to encourage the trade and prepare for the establishment of the new line when the new boats already contracted for are finished. The contracts call for the building of four new 15,000-ton steamers.

The National Rivers and Harbors Congress will convene in Washington on Monday, Jan. 15, 1906.



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OPEN SHOP.

There is good reason to believe that shipping legislation of some sort will be enacted during the forthcoming session of congress. The Merchant Marine Commission is at present meeting in Washington for the purpose of forming a program of action for the session. During the year various forces have contributed to a general agitation of the entire subject, and it has been brought home to the people in more ways than ever before. The fruit of this agitation remains to be seen, but from what can be gathered in interviews with leading men in congress and also in the administration, the outlook is favorable for the passage of a bill. During the year a number of organizations not in any way identified with shipping have urged the passage of some bill that would tend to restore the American flag to the high seas. The most characteristic of all these resolutions was adopted by the American Bankers' Association in session at Washington. There is a conviction among manufacturers and bankers that the United States should possess its own mode of transit

abroad. At the present time it hasn't vessels enough to carry its own mails, a portion of the American mail subsidy now being earned by British lines. What is needed is a fleet in the foreign trade as capacious as the American fleet which now carries the commerce of the great lakes. In the event of foreign complications, the foreign commerce of the United States would inevitably back water and swamp the home market. It could not do otherwise since the United States possesses no ships to take it abroad. The registered tonnage of ships engaged in the foreign trade of the United States is less now than it was nearly a hundred years ago, while every other department of industrial life has vastly multiplied. There is a reason for this condition. It lies in the fact that the United States has protected every industry except shipping. As a result the American ship is practically extinct. The question before the country now is "Shall the American ship be restored to the high seas"? There is only one way to do it, and that is to remove the unequal conditions which now exist. American shipping in the foreign field is laboring under a severe handicap. It will not prosper until that handicap is removed. It can be removed only by congressional enactment. The signs fortunately are, however, that it will be removed during the present session of congress.

The season at present drawing to a close on the great lakes has, in a commercial sense, been the greatest ever known. More freight has been moved on the chain of great lakes this year than ever before. The total movement of Lake Superior alone is over 40,000,000 tons, which is practically four times the interchange of commodities between Europe and the Orient via the Suez canal and is also equal to the combined commerce of London, Liverpool, New York and Hamburg. The facilities with which this enormous trade has been handled in the brief time in which it is possible to handle it, speaks volumes for the ingenuity with which the problems connected with it have been met by the interests associated with great lakes trade. The ships have moved it easily and the docks have handled it readily. In point of fact, up to the time in which it was necessary for the railways to divert their car equipment to other trades, owing to general increase in the country's business, there was practically no delay at either shipping or receiving docks. Ore moved in a constant and unending stream from mines to furnaces, and practically 80 per cent of it did not halt in its transit at the receiving docks. It went directly into cars. More ships however could have been used than were available for the lesser trades, such as coal and grain, and vessel owners have probably been wise in placing orders so abundantly for new ships for 1906 delivery. There will probably be enough work for all of them to do next year. In fact, the vaulting imagination of one year is beggared by the reality of the next in lake commerce.

STORM ON LAKE SUPERIOR.

The distinguishing thing about the storm which raged on Lake Superior during the early part of the present week was the fact that its harvest consisted of modern steel freighters and not, as was the case in the September and October storms, the old wooden craft. The storm again emphasized the singular peril of lake navigation owing to the proximity of the shore line. Had there been searoom probably none of the craft would have been lost. Those that were lost were pounded to pieces on rocks or breakwaters. The most pitiable wreck of all was that of the Mataafa which having left Duluth with a cargo of ore turned round in the storm and endeavored to make the harbor again. She was driven against the breakwater and broken in two. The crew in the after part of the vessel, numbering nine were all drowned or frozen in the sight of those who lined the bank, the life saving crew being utterly unable to make headway against the storm. Those in the forward part of the vessel were saved. The steamer Elwood also stranded in Duluth harbor but managed to get inside of the piers before she did so. She will undoubtedly be saved. The steamer Edenborn went ashore on Split Rock and one of the engineers was drowned. The big steamer Wm. E. Corey, probably the finest vessel on the lakes went ashore on the east end of Michigan Island in the Apostle group but ran easily on a sand bottom and is probably not seriously injured. The steamer Coralia with her consort Maia stranded three miles south of Point Isabel, probably not badly damaged.

The steamer Lafayette was driven ashore on Encampment Island about eight miles north of Two Harbors and was so badly pounded that she is probably a total loss. The Manila which was in tow of the Lafayette was also beached but there is a probability that she can be saved. The steamer Crescent City was wrecked in endeavoring to make Duluth Harbor. The barge Madena went ashore on Split Rock. All these vessels belong to the Pittsburg Steamship Co. and as this company carries no insurance whatever, the loss falls entirely upon it. In fact the storm seems to have singled out the vessels of the Steel Corporation, for it either wrecked or beached ten of them.

The steamer R. W. England went ashore in trying to make the harbor of Duluth but was not especially damaged. Other vessels are still missing but no concern is expressed for their safety as they were probably in the lee of some of the numerous islands. The Steel Corporation expects to be able to save all of its stranded ships with the exception of the Lafayette and Mataafa. The storm was unusual in its violence and also in the fact that notwithstanding the heavy monetary loss the insurance companies are not heavy sufferers.

CHICAGO GRAIN REPORT.

Chicago, Nov. 28.—From last report vessels have been under free offering at 3 cents Buffalo corn with rather slow shipping responses. Generally the cash situation notes a weak turn and rates likely to settle at 2½ cents ere the close of the present week on prompt handling business. Buffalo elevators seem to be clearing somewhat, and furthermore, cargo underwriters are disposed to extend the traffic of lake carriers to a reasonable degree after Dec. 5, it seems up to the shipping element to avail themselves of the situation in storage possibilities and otherwise.

The bulk of the handling of the past week is again with the rail lines, as noted in the weekly disbursement:—Via all rail lines of flour, 98,407 bbls.; wheat, 96,479 bu.; corn, 1,008,674 bu.; oats, 1,710,000 bu.; rye, 25,000 bu.; and barley, 286,500 bu. Via lake to Buffalo and other American ports, of flour, 71,850 bbls.; wheat, 134,000 bu.; corn, 345,000

bu.; oats, 465,000 bu. And via lake to Canada points, of flour, 900 bbls.

Lake and Rail Shipments.

	This Week	Last Week	Same Week last year
Wheat	230,479	222,347	395,093
Corn	1,353,074	1,622,501	913,231
Oats	2,175,150	2,455,308	552,990
Rye	25,302	20,874	39,496
Barley	208,501	355,109	283,714
Total	4,053,112	4,682,259	2,184,524
Flour	171,619 (Bls.)	192,198	125,994
Shipments since Jan 1, 1905.			
			Same Time last year
Wheat	12,249,654		16,189,237
Corn	85,012,801		66,386,305
Rye	1,054,870		1,456,008
Oats	58,074,405		43,353,843
Barley	5,846,447		5,180,051
Total	162,238,207		132,565,444
Flour	6,580,489 (Bbls.)		6,576,675
Stocks of grain in elevators.			
	This Week	Last Week	Same Week last year
Wheat	8,812,000	8,802,000	3,931,000
Corn	1,513,000	1,464,000	1,623,000
Oats	13,205,000	13,478,000	9,055,000
Rye	646,000	555,000	419,000
Barley	352,000	342,000	124,000
Total	24,528,000	24,641,000	15,152,000

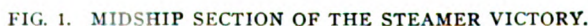
The International Waterways Commission, which recently held a meeting at Buffalo, has by no means concluded as yet consideration of the questions growing out of the diverting of the water of the Niagara river above the falls for power purposes. The opinion of a majority of the engineers on the commission is that whereas the making of contracts for taking water from Niagara river is within the jurisdiction of the State of New York, the actual employment of the water for the purpose named requires the consent of the United States and Canadian Governments. Various possible solutions have been proposed, one of them being a treaty or agreement between the two governments, providing for the control of the water involved. An objection has, however, been raised to this plan on the ground that it might raise the question of "international domain." Should the Canadian Government accept the recommendation of the International Waterways Commission, relative to the placing of restrictions upon the taking of water from St. Mary's river, is expected that the control of the water at the outlet of Lake Superior will be vested with a joint board of U. S. Army and Canadian engineers.

The Isthmian Canal Commission has chartered the two steamers recently purchased by it to the Panama Railroad Co., the commission to receive as a consideration a sum equal to interest at the rate of four percent per year on the cost of the vessels and an additional sum equal to four percent to cover loss from deterioration. The Panama Railroad Co. is to insure the vessels in favor of the Canal Commission for the cost price. This action will place the operation of the steamers in the hands of the Panama Railroad & Steamship Line which, while its stock is owned by the United States Government is managed as a separate corporation.

The steamer Joseph G. Butler, Jr., keel for which was laid at Lorain Sept. 6, and launched Nov. 4, will start on her first trip on Saturday of this week.

MR. W. I. BABCOCK'S PAPER UPON LAKE STEAMERS ATTRACTS A GREAT DEAL OF ATTENTION AND IS MUCH DISCUSSED.

200 gross tons of iron ore. The Victory was also one of the earliest lake ships to be built on the channel system, the floors, frames, web frames, beams, ties and stanchions all being of channel section. The upper deck was of steel complete, without wood covering. The main deck beams were spaced uniformly 8 feet apart, making a beam at each



end of a hatch and one beam in the centre between hatches, the hatches through the upper deck being 8 feet fore and aft and 24 feet centres. No deck was laid on the main deck beams throughout the cargo hold, but a web frame or belt was fitted at each beam end and a stanchion on the centre line, with two rows of ties on each side and steel plate shifting boards below the upper deck on the stan-

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chions. Large brackets were fitted at beam ends and centre line. Fig. 1 shows her midship section.

Throughout the ship, extending from forward collision to after peak bulkheads, was fitted a double bottom 4½ feet deep, of 10 pound plate, stiffened by Z bars and

ful and fortunate ship and a profitable one for her owners, mostly in the business of bringing iron ore from Lake Superior to Lake Erie ports and going back light, but occasionally, when freights were attractive, taking coal up or a load of grain down. In that time, however, and parti-

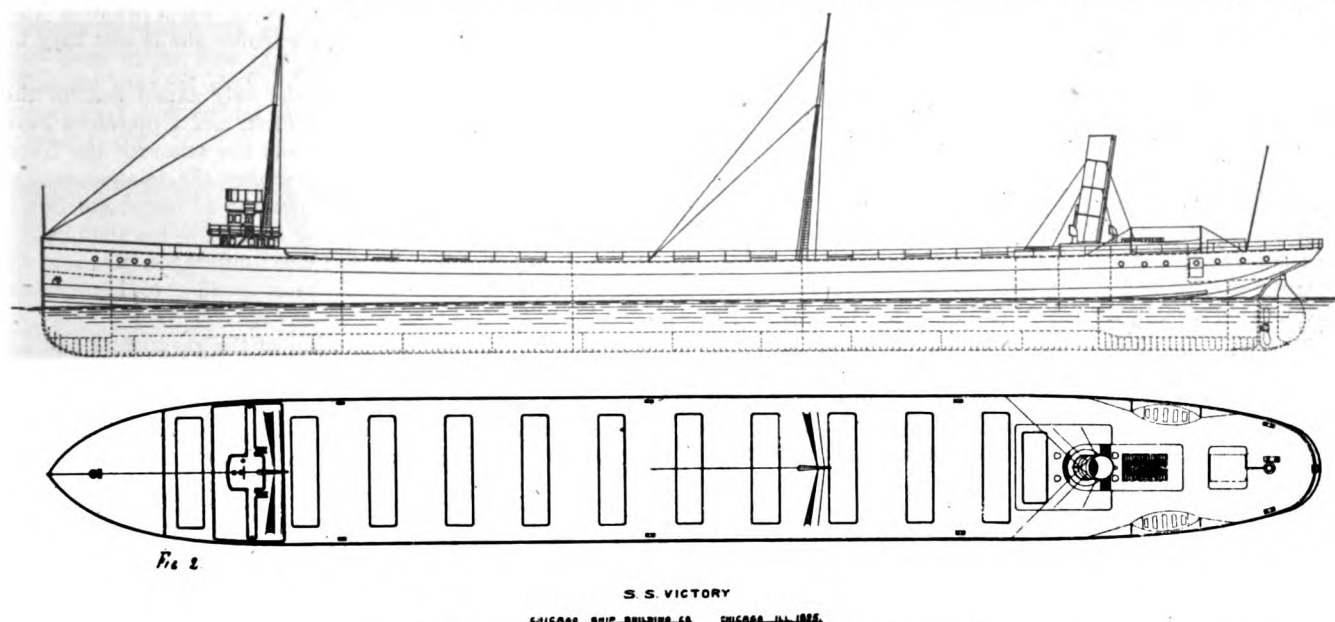


FIG. 2. GENERAL ARRANGEMENT OF STEAMER VICTORY.

covered with 3 inches of oak flooring, supported by continuous longitudinals on top of floors. This bottom was divided by centre keelson and high plate floors into eight water-tight compartments.

cularly in the last two or three years, there has been a great change in the conditions of lake business. This has been mainly caused by the great development that has taken place in the dock appliances for the unloading of

bulk cargoes of iron ore. When the Victory was built, and for years afterwards, the unloading buckets used were ordinary tubs holding about one ton, with four small wheels on the bottom, so that they could be moved about in the hold, and the ore was shoveled into them by hand. Fig. 4 shows the arrangement. It was then an advantage to have the ore pile in the ship as shallow as possible, so that the shovelers could get quickly to the bottom. Now, great hydraulically or electrically operated self-filling buckets or grabs, of five to ten tons capacity, dig their own way into the cargo, and nearly all of it is unloaded without any hand work at all, the shovelers being only re-

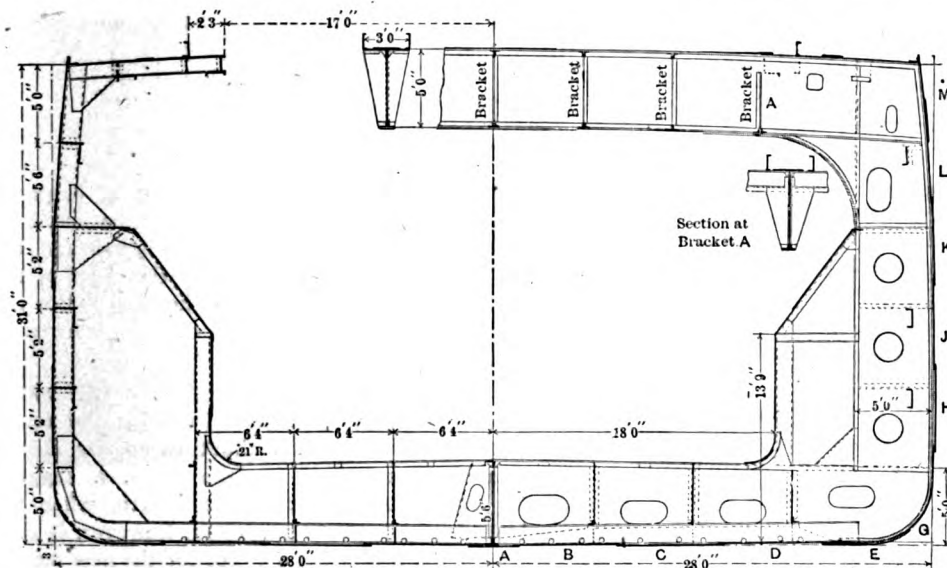


FIG. 5. MIDSHIP SECTION OF THE GARY.

The machinery was placed as far aft as possible, consisting of a triple expansion engine 23 in., 38 in. and 63 in. by 40 in. and two Scotch boilers 14 ft. 8 in. by 13 ft. placed on a half deck about 9 ft. above the inner bottom, facing each other with fire room between and coal bunker next forward.

Accommodations for the crew and three or four passengers are all in forward and after ends of the ship, leaving the deck unobstructed as far as possible for convenience in handling cargo, which is all handled from the docks, there being no hoisting appliances whatever on the vessel. Fig. 2 shows the general arrangement of the ship.

Thus built, the Victory ran for ten seasons, a success-

quired at the last cleaning up the scattered remnants. In operating this modern power bucket in the hold it is evident that the fewer obstructions there are the better, and that the hatches should be as large and as close together as possible. Also, that the ore pile should be concentrated on a small bottom area and, therefore, be deep or high. From these considerations there has been evolved the modern vessel, in which the hatches are 9 ft. wide, spaced 12 ft. centres, the main deck beams and the stanchions omitted entirely, and the tank top bent up to meet the main deck stringer in various forms, but all with the idea of forming a long hopper or trough in which the ore lies and which presents a smooth surface everywhere to the buckets. The amount of water ballast that can be carried

is largely increased at the same time, which is a great advantage, as the boats usually go light to the upper lakes. The strength is made up by carrying a heavy plate girder or arch across under the upper deck between each two hatches, connected to heavy plate webs running right around the ship.

With the increase in the amount of cargo that can be unloaded in a day by this improved machinery and construction and the steady increase in the draught of water available in the Soo and Detroit rivers and the lake harbors, due to Government and private dredging, the size of the vessels has grown steadily also until now there are many on the lakes with a capacity of over ten thousand gross tons per trip each.

As an example of the latest boats the steamer Elbert H. Gary of the fleet of the U. S. Steel Corporation may be taken. This ship is 569 ft. over all, 549 ft. keel, 56 ft. beam, and 31 ft. deep. She has a triple expansion engine 24 in., 39 in. and 65 in. by 42 in., and two Scotch boilers 15 ft. 4½ in. diameter by 11 ft. 6 in. long, and with 10,500 tons cargo on a draught of 19½ ft. makes 12 miles per hour with about 2,000 I. H. P. The cargo has been loaded

The waves met with on the Great Lakes of America are uniformly short, though they may be relatively high. From all the information I have been able to get, I fixed upon a wave 200 ft. long and 20 ft. high as the maximum size likely to be encountered and made the calculations on that wave as a basis. I doubt very much whether this length is ever reached, though possibly the height may be slightly exceeded on rare occasions.

In starting the investigation the only data I had for the Victory were for a draught of 18 ft. and I therefore have used that draught for that boat and the same for the Gary. As my object was only to determine the relative strains due to increase of length and not the actual stress in the material, the actual draught for which the calculations are made does not make any particular difference. During the past season the boats have been loading to between 19 and 20 ft.

For each case the distribution of the cargo fore and aft in making up the curve of weights has been taken from actual records kept on the ship.

For the Victory, each figure gives an outline of the ship, dotted for the increased length, the curves of weight, W

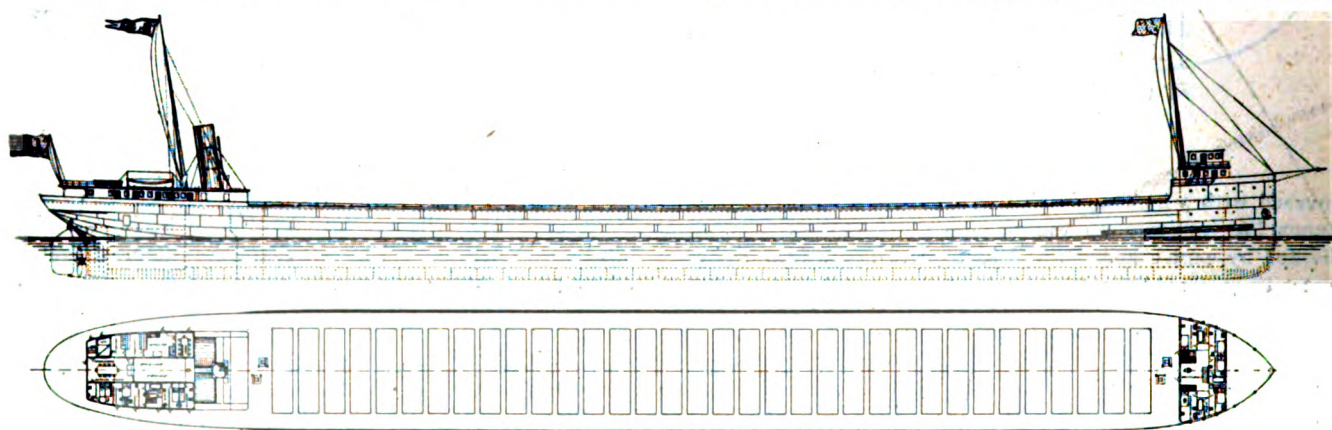


FIG. 6. GENERAL ARRANGEMENT OF THE GARY.

in four hours and thirty minutes and taken out in four hours and ten minutes. This boat has thirty four hatches, fitted with telescopic covers made of steel plate and opened and closed by three special engines on deck through shafting, clutches and chains.

Fig. 5 is a midship section of the Gary, Fig. 6 the general arrangement, and Fig. 8 a view in the hold showing a Hulett bucket at work.

The running expenses of these very large ships are very little more than those of the old boats, practically the same crew being carried, and it is evident, therefore, that the cost of carrying a ton of cargo is very much less. To bring down this cost in the old boats a number of them have been lengthened, increasing the capacity considerably with no increase in the running expenses and very little loss of speed. This was done last winter in the case of the Victory, 72 ft. being added amidships, making her now 452 ft. keel and giving an increase in cargo of some 1,400 tons on 18 ft. draught. At the same time a new steel tank-top was put in without wood covering and the main deck beams were moved away from the line of the hatches, so as to leave as much clear space as possible for the operation of the unloading machinery.

It occurred to me that it would be interesting to investigate the changes in the longitudinal bending moments in a seaway in this ship caused by this increase in length and to compare these also with the bending moments of the largest ships now in lake service for the same series of waves, and I now have the pleasure of presenting the results of this investigation to the Society.

and W', the water or wave lines, the curves of buoyancy B and B', the curves of loads L and L' and the curves of bending moments M and M', for the original and the new lengths respectively, the position of the crest of the wave with reference to the stern being the same. For the Gary there is of course only one set of curves for each wave position.

Fig. 9 shows these curves for the ship in still water, and in it I have added the weight curves for the vessel alone with 100 tons fuel, but without cargo. It shows, what is practically universal in lake ships, a sagging moment for the greater part of the length, when the vessel is loaded, which at its maximum, however, is only 7,000 ft. tons for the original and 11,000 for the new length, being respectively 1-456 and 1-424 the product of the length and displacement.

Fig. 10 shows the curves for the ship in a series of waves with the crest of the first wave coming at the bow of the old length. The maximum hogging moment is 15,800 ft. tons for the old and 1,000 ft. tons for the new length or 1-200 and 1-4670 the product of the length and displacement respectively. The maximum sagging moments are 17,200 ft. tons for the old and 37,100 ft. tons for the new lengths respectively or in fractions as before 1-186 and 1-126.

Fig. 11 shows the ship on a series of waves with the hollow of the first wave at the bow of the old length. The maximum hogging moment is 8,100 ft. tons for the old and 23,200 foot tons for the new length or 1-400 and

1-200 the product of the length and displacement respectively. The maximum sagging moments are 41,400 ft. tons for the old and 24,500 ft. tons for the new lengths respectively or in fraction as before 1-77 and 1-190.

Fig. 12 shows the bending moment curves only, the others being omitted to avoid complication, for wave positions in which the crest and the hollow of the first wave come at the bow of the new length respectively.

For the original ship the hogging moment is 21,800 ft. tons (1-152) and the maximum sagging moment is 34,700 ft. tons (1-92).

Victory, similar calculations have been made on the steamer Elbert H. Gary, which is one of four sister ships which are now the largest in service on the lakes. Figs. 13 and 14 show the curves for this ship, which are lettered the same as in the case of the Victory and explain themselves. The maximum sagging moment for the loaded ship in still water is 40,100 ft. tons or 1-200 the product of the length and displacement. For the various waves shown the maximum hogging moment is 40,200 ft. tons (1-200) and the maximum sagging moment is 97,500 ft. tons (1-84).

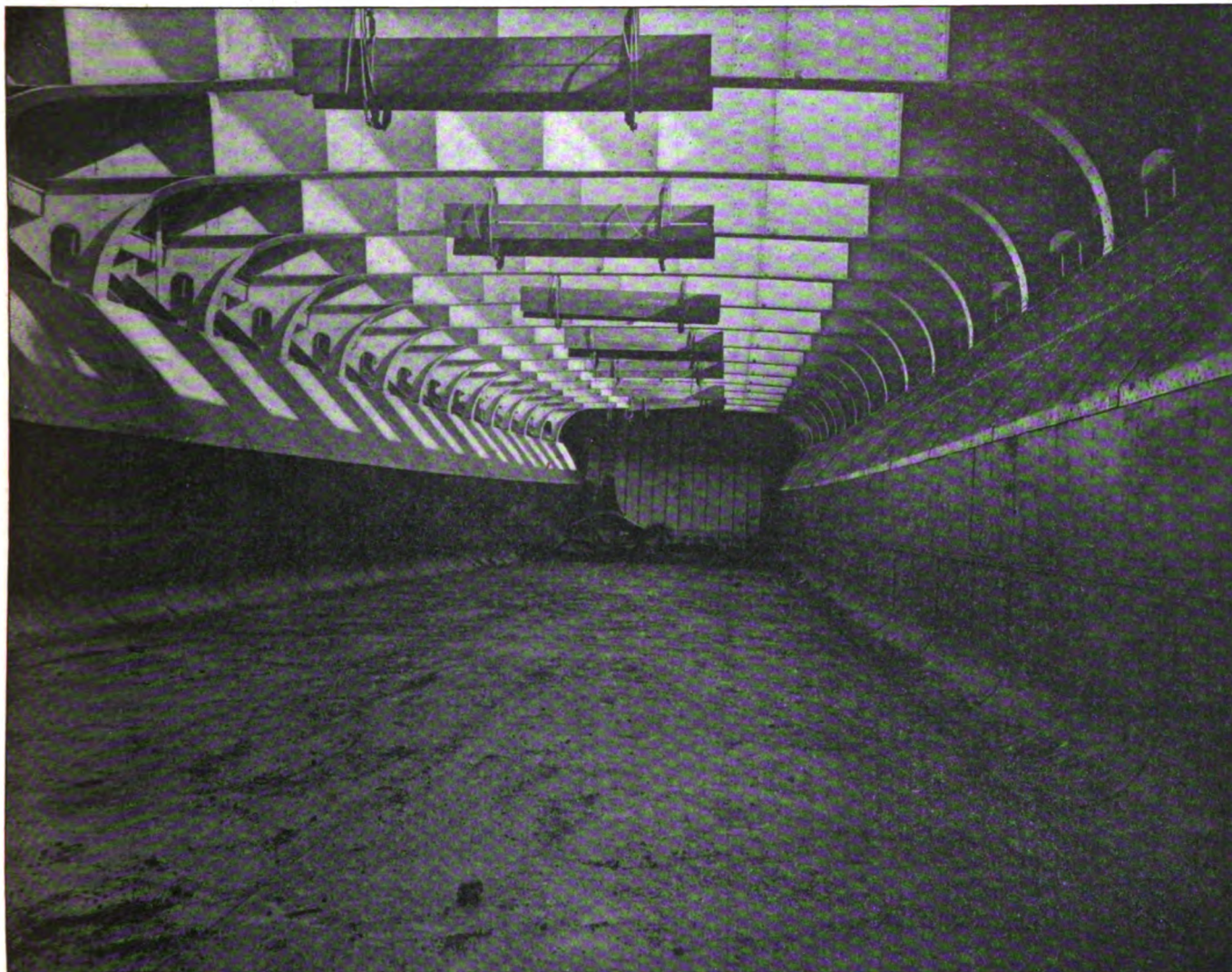


FIG. 8. VIEW IN HOLD OF GARY SHOWING HULETT BUCKET AT WORK.

For the lengthened ship the maximum hogging moment is 26,700 ft. tons (1-175) and the maximum sagging moment is 40,000 ft. tons (1-117).

It is doubtless unnecessary to discuss these various figures in further detail. The drawings are plain and there are a sufficient number of different positions of waves illustrated to give the maximum bending moments which are ever likely to occur. From them we observe that the maximum hogging moment is about 21,800 ft. tons for the original ship and 26,700 ft. tons for the lengthened ship, an increase of about 22½ percent. The maximum sagging moment is 41,400 ft. tons for the original and 40,000 ft. tons for the lengthened ship. In any position which this vessel is ever likely to assume among waves it is fair to believe that the sagging moment will always be considerably in excess of the hogging moment.

For purpose of comparison with the curves of the

Comparison of Fig. 9 and Fig. 13, showing respectively the still water conditions, shows at once an important difference in the two ships. In the case of the Victory the forward hatch is considerably nearer the bow than in the Gary, and there being a cargo space underneath the boilers and the coal bunkers, the ore from the after hatch trims, aft underneath the boiler deck. This results in a more even distribution of the curve of weights for the loaded condition of the ship.

In the case of the Gary, the boiler room and coal bunker extend down to the tank top and the ore at the after end can go very little aft of the line of the after hatch. At the forward end of the Gary the forward hatch is kept back from the fore-castle house to give room for the winches which handle the wire hawsers. The result is that in this ship there is a considerable excess buoyancy both forward and aft of the cargo, whose result is seen

in the curves which show a large increase in the sagging moment. This effect is aggravated by the practice on the Gary of not loading any ore at all into the forward hatch, which is done to facilitate the discharge of cargo, the unloading buckets, working through the forward hatch, being able to reach all of the ore, which would hardly be the case if they were loaded into that hatch. It is usual on the Gary, in order to reduce the sagging moment, to lighten up the amount of cargo loaded into the mid-

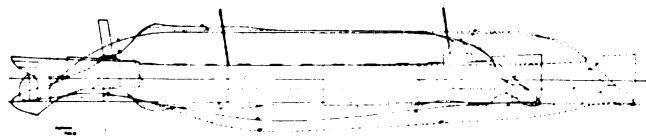


FIG. 9. VICTORY.

ship hatches. This is good practice, but leaving the cargo out of the forward hatch is not to be commended, though it is frequently done in lake ships.

In Fig. 14 a crest of wave No. 2 comes nearly opposite the boilers, where there is already an excess of buoyancy in still water, as shown in Fig. 13, and the result is seen in the increase of the sagging moment a short distance forward.

Similarly wave No. 3, drawn so that its crest comes just forward of the forward hatch where there is again a large excess of buoyancy in still water, causes another very large increase in the sagging moment a few hatches further aft.

The conditions under which the iron ore business of the lakes is carried on make it impossible to avoid these large excesses of buoyancy forward, and aft of the cargo. In a service where the boats can run but seven months in the year despatch in handling cargoes is of the utmost importance. At upper lake ports the ore is simply spouted in from elevated docks. Practically, therefore, everything about the boats is subordinated to the requirements of the

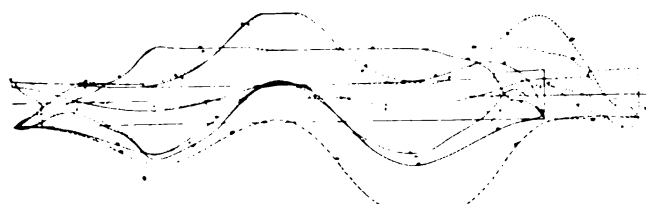


FIG. 10. VICTORY.

unloading machinery at the receiving docks at the lower lakes. If a ship could be built so that she came to these docks with all her ore in one deep pile amidships and the whole upper deck could be taken off to leave this pile open to the dock machinery, possibly then the dock managers would be satisfied. Failing this ideal condition the ship-builder has to come as near to it as possible and take care of the other qualities of his ship as best he can. I will venture to say, however, that nowhere else in the world is there a fleet of ships better fitted to the conditions under which they must work than on the great lakes of America, where boldness and originality of design have had freer scope or been more successful, or where, on the whole, fewer mistakes and failures have been made.

A comparison of the various curves shown in the figures indicates that in any condition of the loaded vessel, in still water or among waves, the sagging moment is in excess, and generally very much in excess, of the hogging moment. Considerable criticism, therefore, which has at various times been indulged in as to the heavy bottoms of lake ships in comparison with their upper works is shown to be largely unwarranted. This construction of the vessel has been a natural outgrowth of the conditions

of the business, which require a very heavy bottom to resist the strains due to frequent grounding and touching in narrow and shallow channels and also to support the weight of the cargo on the tank top and also require the upper deck hatches to be as numerous and as wide as possible to facilitate unloading. These combine to make the bottom heavy and the deck light and therefore considerably lower the position of the neutral axis. It is satisfactory to know that the strains which come upon the ship in deep water among waves are very well met by the same construction, for the compression on the upper deck is always much more severe than the tension and to resist this compression it is comparatively easy to stiffen the stringers by one or more lines of intercostals between the beams as shown in the midship sections illustrated herewith.

If the Gary were in service in salt water instead of in the lakes and therefore liable to encounter ocean waves which are, of course, much longer from crest to crest, the bending moments would naturally be greatly increased. For comparison I have calculated these moments for a

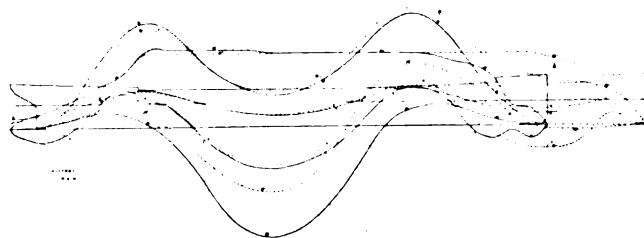


FIG. 11. VICTORY.

wave of the same height as used before, 20 ft., and a length equal to the over all length of the ship, 570 ft., with the crest and hollow at midlength respectively, and the results are shown in Fig. 15. For the crest at midlength the hogging moment is 165,300 ft. tons or 1.33 the product of the length and displacement. For the hollow at midlength the sagging moment is 257,900 ft. tons or in fraction as before 1.21. The hogging moment is about the same as given by White as the maximum for ordinary merchant steamers. The sagging moment is between two and three times as great as given by the same authority. This is the natural effect of the full model of lake vessels,—the box co-efficient of the Gary at 18 ft. being 86,—and the excesses of buoyancy forward and aft as referred to before.

The greatest tensile strain on the deck of the Gary, therefore, is only one-fourth of what it would be if the ship were on salt water and in a series of waves of her own length. The maximum compression on the deck is a little less than two-fifths of what it would be under similar circumstances. If it were not for these facts the very wide hatches of lake steamers would be impossible and the handling of bulk cargoes would be greatly interfered with.

No attempt has been made to investigate the strains on either of these vessels when going up without cargo. From the nature of the case it is practically impossible to do so. In smooth water, water ballast is carried aft only and added forward as the sea rises. There is no question but that in the past various vessels have been greatly abused, water ballast being carried aft only to get the wheel down and the vessel forced against head seas, jumping many feet of her bow clear of the water with a resultant heavy tensile strain on the deck. It is doubtless true also that many vessels are severely strained in unloading, too much ore being taken out at one place before the machines are moved. Definite calculations, however, cannot be made on such conditions.

Since the new power unloaders have brought the hopper

type of vessel into existence the amount of water ballast that can be carried has been largely increased until on a vessel like the Gary it amounts to about 8,000 tons and puts her down to a draught which makes the ship perfectly safe under all conditions.

The United States Steel Corporation has just placed an order for two ships 600 ft. over all length, 58 ft. beam and 32 ft. deep, to come out next year. To reduce as much as possible the excess buoyancy forward in these vessels, the

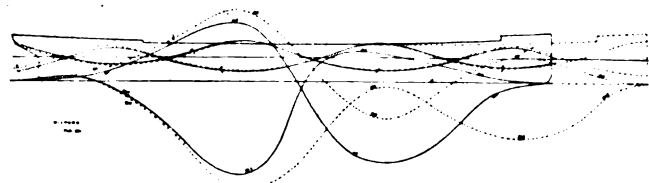


FIG. 12. VICTORY.

forward hatch has been moved close to the forecastle and the third hatch omitted, the winches being placed on the deck in the space which that hatch would otherwise occupy, thereby carrying the ore body further towards the bow.

DISCUSSION ON MR. BABCOCK'S PAPER.

Prof. H. C. Sadler: I think Mr. Babcock has raised some very interesting points with reference to lake steamers. What most struck me was, first the ratio of the length to the depth of these vessels. In the case of the Gary 17.7 and of the Victor 16 only. This, of course is the outcome of the difficulties to be encountered, the limit-

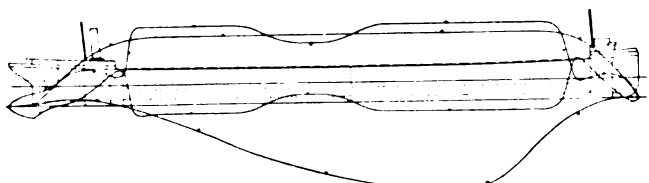


FIG. 13. ELBERT H. GARY.

ed draught to which these vessels can be allowed owing to the shallowness of the channels and the difficulties of the service. Mr. Babcock mentioned a wave 200 ft. long and 20 ft. high as about the most severe wave these vessels are likely to meet. I do not know if any definite measurements of these lengths and heights of waves have been made, but it seems to me that that wave is a little too short. The maximum bending moment as developed in this condition is naturally, as one would expect, rather low, the factor one seventy-seventh being about one-half or one-third of what might be expected for ordinary vessels of the same size of the sea-going vessels. It was very interesting to see that Mr. Babcock had added a set of curves for the bending moment for the deep sea conditions so we can get direct comparisons. I may say that I have a similar set of calculations under way for different heights of waves and shall be pleased to submit them at a later period. Another point that is raised in this paper is the question of the regulations of loading of lake vessels. That is a question that has come up recently and I think Mr. Babcock hits the nail on the head when he says that it is the usage of carrying the greater portion of the ballast at the stern leaving the bow light, and with reference to carrying the greater portion of the load in the middle of the vessel. This is good practice but leaving the light condition forward is not to be countenanced. That this is done with the lake vessels shows I think that an intelligent set of rules for loading as well as unloading would be an advantage to the shippers. No doubt there would be some objections to that on the part of ship owners, but no doubt they would come to that if legisla-

tion were intelligently made. There is also another point on which we need a certain amount of legislation and that is in the larger amount of ballast they should carry in the light condition. This question has been taken up in connection with deep sea vessels within the last few years by the Admiralty of Great Britain which recognizes that the light condition of the vessels is very important so far as sea-going purposes are concerned. On the Great Lakes where the tendency is to load the vessels down at the stern and leave the bow out of water, there is no doubt that under certain conditions these vessels would be very severely strained. There is another point also which I think might be investigated and that is the strain upon these vessels in the inclined condition. These vessels, as is generally known, roll rather heavily and I think it will be found that in the inclined position the strains are more severe than in the upright. Mr. Babcock has said that definite calculations cannot be made under the conditions

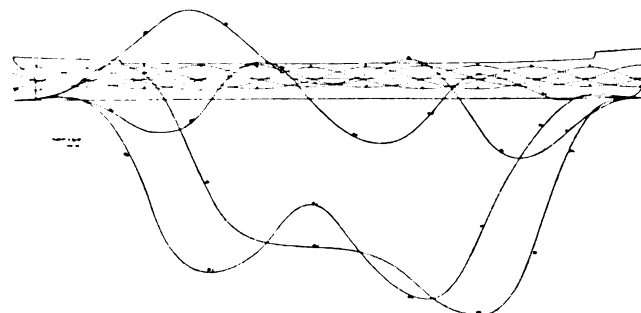


FIG. 14. ELBERT H. GARY.

of too much ore being taken out in one place before the machinery is moved. I do not think that presents any great difficulty. If we give a set of conditions of a vessel loading in a certain way, it would not be a very difficult matter to determine what would happen to the vessel if the ore was taken out, or the bulk of it, in a certain part of the vessel's length. I think it would be very interesting if those calculations were made.

Capt. William Hovgaard: I know very little about lake steamers, and I am glad to get so much interesting information as this paper gives us about this matter. Mr. Babcock mentioned the new methods of loading and unloading these steamers by self-filling buckets. I think it is extremely interesting, and I suggest if possible a diagram or sketch of these buckets be added to the paper.

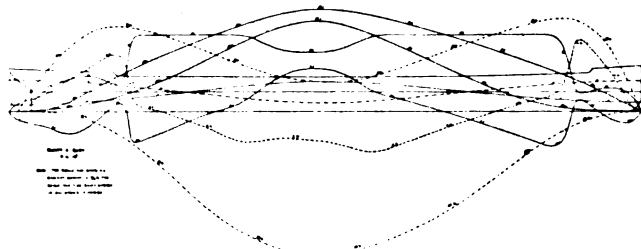


FIG. 16. ELBERT H. GARY.

As regards the wave length, I think like Prof. Sadler, 200-ft. is rather short. I have not been upon the Great Lakes, but upon other bodies of water not as great I have observed waves 200-ft. long several times, and I think it would easily come to that on the lakes, for that reason. Like Prof. Sadler I think that it would add considerably to the interest of the paper if Mr. Babcock would give us the maximum stress in addition to the bending moment. Of course the bending moment may be very interesting in ships which are so alike, so similar, but when we come to comparing ships of different construction and different bending moments it does not give us a means of comparison. And therefore I think it would add considerably

to the interest of the paper if the maximum stress were given.

Mr. D. H. Cox: I am wondering if the members appreciate the immense amount of work that must have been done by Mr. Babcock in preparing the paper with which he has entertained us. If any one of us has gone to the trouble of making calculations for one ship he may possibly have some idea of the work involved and I do not believe there would be many good enough to turn out such a paper for the Society and we ought to be very grateful to Mr. Babcock. I think the paper very interesting to every one who has ever thought about vessels at all, because I think all felt that the vessels for the lakes are different from anything in the world because of the restrictions as to length and draught. For that reason I consider that the addenda that Mr. Babcock has made to his paper, which shows that if these vessels were used on the Atlantic, where they were liable to meet waves of increased length, he has assumed that the stress produced, particularly the tensile strain would be four times that which is met with at the lakes, probably shows why it is these vessels have been built. As with the other speakers it occurred to me that the matter of maximum stress would be very important, and I hope that Mr. Babcock would give that, would be kind enough to give that in some of these vessels.

Mr. D. W. Dickie: I feel greatly indebted to Mr. Babcock for the information given in this paper. I have been wondering for a long while why these lake ships were not built with a "U" shaped hold in the center and hatches hung on the sides so as to fold up and form a herder on the side. Though from the conditions I thought all the time that the reason it was not done was because the means they had of handling the cargo was sufficiently good, and the difference between the cost of handling the cargo in the present way and with the "U" shaped hold was not enough to pay them to make any changes. Because you could put the present tank right amidship and make it "U" shaped, which would put the load in one bulk.

Theodore Lucas: I beg to say that I agree with Capt. Hovgaard that by this calculated stress we have a means of comparison and it should never be looked upon as useless, although we know of vessels running across the Atlantic ocean, in constant use, with a stress of nine tons which are secure and we therefore are pretty safe in designing new vessels for a stress of nine tons. So far as comparisons go this is a basis to start with, if we make our calculations all in the same way.

A great many more calculations have been made as to Atlantic steamers, while the lake steamers have hardly been touched. I think the question of stress would be interesting to us. Since Mr. Babcock is here to supply it I would like to request information as to the actual results and I think it we have that it would be very useful. I would like to know whether under special conditions the ships show this whether any buckling takes place, in places, that has to be straightened out, or if there is a tearing. Back some years ago one of the lake steamers was lost and it was stated at the time that it was due to tearing, that means a tear that produced a break. Perhaps the information with which Mr. Babcock is supplied may enable him to tell us which is the probable or possible cause whether the sagging moment produced or caused a buckle or break in that way. And I would like to have Mr. Babcock's opinion, if he can give it to us, as to which of these causes the trouble was due.

Mr. A. J. MacLean: I have had some experience in these calculations and I would like to make a few com-

ments in Mr. Babcock's favor. I think we are very thankful to him for giving us this information, first regarding the length and depth of the waves. I suppose he has better authority on that matter than any of us. It seems to me from a careful observation of deep sea waves that I have made he certainly has got the extreme depth for the length of wave. I would like to state that a short time ago I was asked by some authorities in this city to make these calculations for an oil steamer of the usual depth and 450 ft. long. And this was a case wherein they wanted to put the machinery amidship, and the question was which was the strongest ship. I went through all these long calculations for this particular ship and found that a ship with the engines amidship and central bulk heads was the stronger. There is one thing in the paper of Mr. Babcock's for which I feel grateful. He has incidentally stated the fact that the stresses on salt water are some four times as great as on fresh water.

Mr. J. E. Thayer, inspector Bureau Veritas for Pacific coast: I am practically unknown to the people here today but I am familiar with lake ships and the inspection on the Pacific coast. To us on the Pacific coast have come a number of lake vessels. The lakes build cheap ships and we are all the time thrown up against lake competition. They want to send us their ships at their prices. Their prices cannot be met on the Pacific. Nor does their construction meet the conditions of the Pacific Ocean. Another point in connection with these lake ships is the position of the weights as is shown in this paper. As everybody knows it is the practice on the lakes to carry to a load to a port and leave with a load. The Pacific coast service is decidedly against that practice unfortunately. The most of our cargoes come down the coast, come from the north, and ships returning must go up against heavy north-east winds and long seas which has in many cases resulted in very serious damage to our ships. I have in mind three ships that came to the coast on a yearly charter. The first came with but 800 tons of water ballast, for that kind of service and soon had her forward end beaten in by the seas. Repairs were made and she started again and in another month or two she had the same result, so to finish out the year's charter she had to carry 1000 tons of rock ballast additional. They did not want to be continually taking it in and putting it out and so they put a thousand tons of rock in the ship and completed the charter. I have in mind another ship that came to us, she is in the service there at the present day and has been there for five or six years. When she arrived she had about 800 or 900 tons ballast. That was not sufficient and they eventually put into her an additional deep tank of 950 tons and made a success of her. But the lake vessels that have come to us have always failed to meet the conditions of the coast there and I would like to see that fact worked out and placed properly before the ship people. I run up against people who have had experience on the lakes and they assert that the same conditions pertain there as do on salt water. The facts show differently.

Mr. George L. Craig: I have heard the remarks of the gentleman about lake built ships. We have built several ships that went to the Pacific coast and each one was built according to specifications. I would like to ask the gentleman if they were built according to classification what is the matter with the ships?

Mr. Thayer: They were built according to classification for lake service.

Mr. Craig: These ships that I have mentioned were built for ocean service.

Mr. Antonio C. Pessano: I am not a member of this

Society, but I am a member of the Mechanical Engineers Society and hope before long to be a member of this Society. With your permission I would like to ask the gentleman to state in what specific way these lake vessels failed.

Mr. Thayer: The lake vessels that have come to us and failed did so on account of the light weight for the forward end of the ships and the excess weights aft. They have not sufficient ballast to go up light against the head seas, and on the coast that is one of the important things because of the lack of cargo going north. I must say the conditions of the Pacific coast are such, the trade that I have mentioned, going up in ballast, it is very hard to build a ship suitable for the trade. These ships of 3000 tons capacity come to us with 800 tons of water ballast, which is not sufficient, and we have to increase that to practically one-third of the cargo capacity.

Mr. Craig: The gentleman has made the statement that they were cheap ships. I would like to know whether they were cheaply built or good ships at cheap prices. I would like to know if he can name the ships built on the lakes that were ever lost on the Pacific coast.

Mr. Thayer: The Kenimore was destroyed in a storm. We never knew what became of her. In reference to the cheap ships, I think we get what we pay for, but we do not get good ships. The Kenimore disappeared off the coast of Alaska and we never knew what became of her. She was built cheap.

Mr. E. Platt Stratton: The Mackinac and the Kenimore were the first two ships that were ever built on the lakes and brought to the Atlantic. They were built according to the rules of British Lloyds and built under my personal supervision. The Mackinac I think was the first to come down. She was brought to Montreal in two sections. She went into service at Montreal and did service between there and Rio Janeiro and did service between New York and the Pacific. It is generally known that the Kenimore went out of existence in collision with another ship, I forget the name, and the debris from each of them was afterwards picked up. The Mackinac is there today, the sister of the Kenimore.

Mr. Thayer: One thing I would like to mention in connection with these ships. One had a dent in her stern that was made with her own stem.

Mr. Craig: I think that needs a little explanation. The ships were taken down the Canadian Canal in two pieces and when they got to Montreal the stem rammed the stern.

Mr. John Reid: I am a stranger here, but I wish to say that it gives me great pleasure to be here and attend this meeting. I am engaged in deep sea work but for the last year or two I have been interested in many respects in the lake ships and perhaps I can entertain you for a few moments. A few years ago the modern grab buckets were invented and from the necessity thus created has been evolved the modern lake vessel of which a large number have jumped into existence within the last three or four years. I would like to show you some elements of their early evolution and change. I would say that some years ago an English friend of mine who had great trouble with the style of vessels then in use wished to evolve a steamer very much similar to what you have on the lakes. They wanted to operate such vessels and wished to design special discharging facilities and their idea was somewhat as follows. (Draws diagram on board.) This was the way the tank was to be formed both fore and aft, and this space should be preserved for the water ballast. The ships were to be built entirely for ore carriers. That was away back in 1898, and when I was coming out to the

lakes in 1899 they asked me to look around here and report to them on the subject. I happened to go to Conneaut and saw the Hulett clam shell working there or rather it was broken down. The bucket had just got round one of the beams and tried to lift it out. I reported to my people that the Hulett was to be the pattern for the lakes and that a new design of ship would be required to meet its conditions. And I told them it would answer very well in order to get more room for the machine to operate it that they could do it in this way (indicating a design of midship section on board) and my friends thought it would not be a bad idea to design a ship in this way and they got up a design. That was in 1901 and some three years after that same idea seems to have struck your American ship builders. What was it they did? They had this steel deck here and they had that deck in this form (indicating on board) and they brought that down to that (indicating). That did not work very well because the ore did not slide properly and then they decided to make it in this way (indicating). But that did not do very well because the power buckets struck this here and damaged the vessel. And after they decided it would be best to make it like this. And afterwards it was found that you could get just as good results by bringing this out and making some water ballast and get the use of such water ballast. (The speaker in the last few sentences illustrated the various modifications which have been made in the form of the hopper construction since the Wolvin was designed.) I would refer to page 6 of Mr. Babcock's paper. This ship could be built that way (indicating) with the ore in one bulk amidship and perhaps then the ore buckets would have enough space and we could take out these beams and have this open from end to end. I think after a while the builders will come to the conclusion to adopt this plan.

The chairman: Any more remarks upon Mr. Babcock's paper? If not I will ask Mr. Babcock to make such brief replies as he desires to do.

Mr. Babcock: I am very much pleased with the reception my paper has met with and the very interesting remarks from so many gentlemen in regard to it. Several gentlemen have spoken of an addition to the paper in the shape of exact calculations of stress. The midship sections as given is practically all the information in the paper to make such calculations and I would very glad to turn it over to anybody that cares to go into it. (Laughter.) I selected the title of this paper with some care and you will observe that the title is "Longitudinal Bending Moments of Certain Lake Steamers," and not stress. I have been working since—I think I started this thing last February—and it has taken every spare moment of my time since, and I did not even then succeed in finishing it when the paper was sent out to be printed. And I say that anybody that wants to go into the actual stress or bending moments in any inclined position of the ship is at perfect liberty to start and I shall wish him God's speed. In lake ships of course the proportion of length to depth is very small. That is a very necessary result from the conditions of the lakes. The present loading docks from which the ore is spouted into the ships are only a certain height. If the top of a ship that comes to that dock is higher than the chutes the water ballast has to be run in to get her down in order that the spouts can be lowered into the holds and the ore run in from these cars above, and you have then got to pump that water out, and if you have put in a great deal of water it takes a great deal of time to pump it out even with the very large pumping facilities which are provided on lake ships. Experience has shown without any question that the ships are deep enough. Of course as the channels of the lakes are deepened so that boats can

load deeper than they can be made deeper. Now, gentlemen, if you think the wave lengths I have used in these calculations are too short, I have never had the fortune, or misfortune to be out on the lakes in a heavy storm, but I have talked to a great many people who have been and asked them their opinion of the size of the waves and the greatest length that I have ever heard was 150 feet long and I added 50 ft. to that to try to make sure to get as big a wave as ever would be. I do not know any accurate measurements that have ever been made. As Prof. Sadler remarks in regard to legislation limiting the loading and handling of vessels I can only say that I do not think that is practical. I guess the vessel owners of the lakes, as well as in some other parts of the country think that they have enough legislation now.

Mr. Hovgaard asks for a plan of the bucket to be added to the paper. He will find on plate 8 there is a photograph of the Hulett bucket, shown in the ship and the upper part of that bucket, is shown on the other figures of the Gary at

likely the builders of the ships which have shown that trouble are not responsible in the slightest degree. The ship builder has to build a ship according to specifications given him and if the owner does not know the condition and does not instruct the ship builder I do not think the builder is responsible. The ship builder is bound to build a ship as instructed and at the cost, and if there are special reasons why a ship should be strengthened in special parts and he is not told of that in order to put it in, I do not think he is to blame. I do not think there is anything more that I wish to say except to thank the members for this kind interest and attention.

Upon motion of Mr. D. W. Dickie a vote of thanks was tendered to Mr. Babcock for his interesting paper.

PAPER ON COMPARISON OF RECENT BATTLESHIPS.

In the absence of Naval Constructor H. G. Gillmor his paper upon the subject "A Comparison of Recent Battleships," was read by Mr. D. H. Cox. The paper follows:

"Including vessels to be laid down before the close of

TABLE I.

	Vermont.	Lord Nelson.	Katori	Deutschland	Vittorio Emanuele	Democrat.	Type Design.
Length between perpendiculars	450'	410'	420'	398' 6"	435' 6"	438' 9"	435'
Breadth, moulded	70' 10"	79' 6"	78'	72' 9"	72' 6"	79' 6"	73' 6"
Draught, mean	24' 6"	27'	27'	24' 6"	27' 3"	27' 6"	..
Displacement, in tons	16,000	16,500	15,950	12,997	12,624	14,635	..
Indicated H. P. with forced draught	16,500	16,750	16,000	16,000	19,000	18,000	..
Speed in knots, with forced draught	18.0	18	18.5	18.0	22.0	18.	18.0
Armament:—							
Main battery	4-12" 8-8"	4-12" 10-9.2"	4-12" 4-10" 12-6"	4-11" 14-6.7"	1-12" 12-8"	4-12" 10-7.6"	2-12" 14-6.7"
Secondary battery	12-7" 20-3" 12-3 pdrs. 8-1 pdrs.	37 small.	10-12 pdrs. 3-3 pdrs. 6-M.	22-3.4" 4-1.4" 4-M.	12-3" 12-1.8"	26-1.8" 2-1.4"	10-12 pdrs. 3-3 pdrs. 6-M.
Torpedo tubes:—							
Above water	3	4
Submerged	4	4	5	6	2	2	..
Armor:—							
Length of water-line belt	Whole l'gth.	Whole l'gth.	Whole l'gth.	Whole l'gth.	Whole l'gth.	Whole l'gth.	Whole l'gth.
Thickness of water-line belt at amidships	9"	12"	9"	9.5"	9 3/4"	11"	9"
at ends	4"	6", 4"	5"	4"	4"	7"	4"
Bulkheads	7"	..	6"	6"	6"	..	6"
Length of upper belt	2-3 length.	3-4 length.	2-3 length.	3-5 length.	1-2 length.	Whole length, narrow.	1-2 length.
Thickness of upper belt	7"	8"	6"	8"	7.8"	8"	6"
Protection, largest guns	12", 8"	12"	10"	10", 6"	8"	6"	6"
Protection, medium caliber guns	6 1/2", 6"	8"	6"	6 1/2"	6"	6"	6"
Coal supply, normal	900	900	750	700	1,000	905	700
Coal supply, bunkers full	2,200	2,500	1,800	1,800	2,000	1,825	..

the unloading dock. Mr. Dickie's idea that lake vessels could be built with one hatch hold in them and added to that hatch covers that would fold into the center is not practical at all. It would interfere with the ore sports. If he can get up any better hatch cover than is now used on the lakes there is a tremendous field for him there. Many people have been working on that for a great many years. The telescope hatch seems to be the best thing and there are a great many objections to that.

Mr. Thayer's remarks with reference to the failure of lake ships on the Pacific Coast have been pretty well answered by other speakers. I am very glad Mr. Pessano asked him in what respect these ships show failure, and as far as I can understand from Mr. Thayer's reply the failure has been shown forward because of the fact of their going up light against heavy seas, and have been smashed in by the seas. I have heard of that before and I have no doubt that is what happened to them. I do not think lake ships alone have been the only ships that have shown trouble of that sort. And I would like to say further that very

the present year, the six maritime powers of the world, Great Britain, France, United States, Germany, Italy, and Japan, have under construction forty-seven battleships varying considerably in size and characteristics. From time to time as facts regarding the vessels laid down by the several powers become known, comparisons on the basis of gun fire, protection, speed and other features are made. That such comparative studies are of interest in the development of naval design is evidenced by their frequency, and the number of systems upon which they are based; ranging as these have, from what has been aptly termed 'comparison by instinct, to mathematical comparisons of considerable complication. The purpose of the present article is to compare from the point of view of the designer and builder, the latest battleships of each of the six powers named, regarding which reasonably accurate information is available. The vessels selected for this comparison are: Vermont, American; Lord Nelson, British; Katori Japanese; Democrat, French; Deutschland, German, and Vittorio Emanuele, Italian.

With a view to presenting graphically the chief characteristics of the several vessels, small sketches of them, all upon the same scale, have been assembled upon a single sheet, plate, to which reference is suggested. The shading of the armor on this sheet has been arranged to illustrate both the extent and the approximate thickness of the protection employed.

In the number and position of the large caliber guns, less variation, is observable among the vessels here considered than would generally have been the case with a similar comparison of vessels of the same nationalities in the past. In all of the vessels except the *Deutschland*, the largest caliber gun provided is 12-inch. In the *Deutschland* 11-inch guns are employed. The number of large caliber guns, namely, four mounted in pairs, two forward and two aft, is the same for all of the vessels excepting the *Vittorio Emanuele*, in which two 12-inch guns, mounted singly, one forward and one aft, have been provided for, the designer of this vessel holding that the large slow-firing guns at the bow and stern would not determine the character of the engagement in its early stages, but are rather to be reserved for destruction of the enemy at close range.

The system of protection employed for these large caliber guns is, as well, almost uniform. They are all mounted in armored turrets or their equivalents near the ends of the vessel; with barbettes of large diameter, or smaller diameter armored tubes, for the protection of the turning elevation and other gun mechanisms and the ammunition supply. Leaving out of account the 8-inch armor for tubes and turrets which the designer of the *Vittorio Emanuele* employs, the differences in thickness of the armor protecting these gun positions is not great; varying from 10-inch for barbettes and 12-inch for turret face plates in the *Vermont*, *Katori* and *Deutschland*, and 11-inch for the *Democrat*, to 12-inch for the exposed portions of the barbettes and turntables in the *Lord Nelson*.

A comparison of the intermediate caliber guns of these vessels is of especial interest on account of the suggestion, receiving serious consideration, to suppress entirely the intermediate caliber guns and introduce in their stead larger numbers of the largest caliber guns. The tendency has been steadily to increase the caliber of these intermediate-caliber guns; and if the battleships here considered were compared with some of their early predecessors, this increase in caliber would be very noticeable. Among the vessels under consideration there is a wide range in the caliber of the intermediate battery.

In the *Katori* there are four 10-inch guns mounted singly in barrette, and a central battery of twelve 6-inch guns. In *Lord Nelson* the intermediate caliber guns are uniformly 9.2-inch, mounted eight in pairs, in barrette, for bow or stern and beam fire, and two singly for beam fire. In the *Vermont* there are eight 8-inch, mounted in pairs in turrets for bow or stern and beam fire, and a broadside of twelve 7-inch guns on the deck below. In the *Vittorio Emanuele* the intermediate caliber guns are regarded by her designer as the main battery of the vessel. She has 12 8-in. guns, mounted in pairs in turrets, two amidships, two forward and two aft, to fire over wide angles. In the *Democrat* there are ten 7.6-inch guns mounted six in turrets and four in casemates. The *Deutschland* is provided with fourteen 6.7-inch guns mounted, ten on the gun deck in an armored central battery and four in casemates giving bow or stern and beam fire.

With the variations in the second caliber guns there will be noted considerable difference in the method and degree of protection given these guns. When intermediate caliber guns above 7 inches in diameter are provided for in any of the vessels considered, they are, except for four of the guns of the *Democrat*, mounted in turrets or their equivalent, and protection to the guns and ammunition supply given by curved

armor and armored tubes, assisted in most cases by the side armor of the vessel. The thickness of curved armor for the protection of the guns varies from 6 inches in the *Vittorio Emanuele* and *Democrat* to 8 inches for the 9.2-inch guns of the *Lord Nelson*. The extreme of isolation and protection of the second caliber guns is seen in the *Democrat*, in which the 7.6-inch guns are mounted singly, six in turrets with 6-inch curved armor protecting both the guns and the ammunition supply and gun operating mechanisms, and four in casemates protected by 7.6-inch vertical armor. Where guns 7 inches and below in caliber are employed they are mounted in central battery, protected by vertical side armor the thickness of which is 6 inches on the *Katori*, 6¾ inches on the *Deutschland*, and 7 inches in the *Vermont*.

In the extent of protection for the waterline there is substantial uniformity, all of the designs providing for complete water-line belts. The thickness of the armor for these belts varies, however, considerably. The maximum, 12 inches amidships and 6 to 4 inches at the ends, is provided for in the *Lord Nelson*, while the *Democrat* has a narrow belt 11 inches amidships and 7½ inches at the ends. The thickness of the water-line belt on other vessels considered varies from 9 inches to 9¾ inches amidships, tapering in thickness toward the ends to about 4 inches.

A greater variation is to be noted in the length and thickness of upper belt armor. In the *Democrat* a narrow upper belt, which virtually is a part of the water-line belt, though for the purpose of comparison considered separately from this belt, extends for a full length of the vessel, having an amidship thickness of about 8 inches, tapering toward the ends. The extreme in the other direction is found in the short upper belt of the *Vittorio Emanuele*, extending for about one-half the length of the vessel, having a thickness of 8 inches. The upper belt of the *Lord Nelson* has an amidship thickness of 8 inches and extends from the after barrette to the bow, tapering to 4 inches in thickness at the bow. The *Vermont*, *Katori* and *Deutschland* have upper belts, extending from the forward to the after heavy gun positions, and varying in thickness from 6 inches on the *Katori* to 7 inches on the *Vermont* and 8 inches on the *Deutschland*.

In the matter of speed there is, except for the 22-knot *Vittorio Emanuele*, which her designer has termed a compromise type, greater uniformity in this element than would have been the case generally in the past. The speed provided for in all of the other designs except the *Katori* is 18 knots. The *Katori* has a design speed of 18½ knots. In coal carrying capacity the low limits are found in the *Deutschland* and *Katori*, providing for 700 and 750 tons respectively on the trial displacement, with 1,800 tons maximum stowage capacity. From this the coal provided for in the designed displacement ranges from 900 tons for the *Vermont*, *Lord Nelson* and *Democrat*, to 1,000 tons for the *Vittorio Emanuele* with a total stowage capacity provided for ranging from 1,825 tons for the *Democrat* to 2,500 tons for the *Lord Nelson*.

One of the things most noticeable in the table of characteristics given above, is the wide range in displacement of the vessels, rising from 12,624 tons for the *Vittorio Emanuele* to 16,500 tons for the *Lord Nelson*. The past decade has brought a substantial increase in the displacement of battleships for all the naval powers and indications are not lacking that the limit in size has not yet been reached. Increase in displacement necessarily involves an increase in unit cost, and we have seen the cost of hull and machinery for our battleships increase successively from \$2,250,000 for the 11,700 ton *Kearsarge* and *Kentucky*, \$2,885,000 for the 12,850 ton *Maine* class, \$3,600,000 for the 14,950 ton *Virginia* class, to \$4,150,000 for the *Vermont* class. The experience of other naval powers has been similar. The perusal of a recent paper by Lord Brassey, bearing upon this question of increasing unit cost and total naval expenditures and the discussion which followed

its presentation, suggests the desirability of including, in the comparison of the vessels of varying sizes here considered a comparison of their probable costs, on the basis of the cost of American-built vessels. The cost has been separated into three divisions: hull and machinery, armor and armament, and the totals of cost are for the vessel complete as to hull, fittings, machinery, battery and armor, but without the various stores, etc., necessary to her preparation for first commission. The cost of hull and machinery has been estimated by estimating the dead weights of material in hull and machinery in tons and applying to these weights the known cost per ton dead weight of material for the latest American-built vessels of about the same size. The costs of armor and armament have been similarly estimated by estimating the weight of armor the several designs, and applying to these weights the prices per ton of corresponding materials for our own vessels. The estimates under each of the three divisions and the total for each are given below in tabular form:—

TABLE II.
Estimated Costs.

	Lord Nelson.	Vermont.	Katori.	Democratic.	Deutschland.	Vittorio Emanuele.
Hull and machinery	\$4,138,000	\$4,020,000	\$3,993,000	\$3,820,000	\$3,381,000	\$3,317,000
Armor	2,005,000	1,760,000	1,707,000	1,740,000	1,500,000	1,290,000
Armament	1,186,000	1,338,000	1,151,000	955,000	990,000	832,000
	<u>\$7,329,000</u>	<u>\$7,118,000</u>	<u>\$6,851,000</u>	<u>\$6,515,000</u>	<u>\$5,871,000</u>	<u>\$5,439,000</u>

As was to have been expected, the vessels rank in order of cost as they do in order of displacement.

While a general idea of the relative naval values of the several vessels considered may be had from an examination of the table giving the chief characteristics and from the accompanying plate; the differences among the vessels, which have been pointed out, preclude anything like an accurate recourse to some system. For the purpose of such a comparison, and with a view to reducing the expression of relative values of the several designs to numerical terms, a modification of the method outlined in a paper read before the Society in 1901, has been followed. It was then proposed to establish a basis of comparison by assuming a vessel, whose dimensions were those of the largest vessels under consideration; in which the features of armament, protection, speed and coal supply embodied were the minima of these several features which might be found among the vessels under comparison. A result of the selection of the largest of the vessels for a type design was to give excessive weight to the speed feature in the numerical expressions for naval value derived by reference to the type design. To avoid this magnification of the value of speed, and establish a suitable basis of comparison, for the type design there has been assumed a vessel the form of which is such that, with the designed horse-power of the fastest of the vessels under consideration, she would be capable of the speed proposed in the fastest design at about the displacement of that design; but for the purposes of the comparison, assumed to have the least speed and minima of the other features of armament, protection and coal carried on design displacement to be found in any of the vessels being compared.

This type design will then be a vessel about 435 feet in length and of the general proportions of the Vittorio Emanuele; having a speed of 18 knots (that of all of the vessels under consideration except the Katori); a normal coal supply of 700 tons (that of the Deutschland); a battery of two 12-inch guns (the largest caliber guns of the Vittorio Emanuele), fourteen 6.7-inch guns mounted in a central battery and casemates (the intermediate caliber guns of the Deutschland) and secondary battery consisting of ten twelve-pounders, three 3-pounders, and six Maxim guns (the secondary battery of the Katori); two submerged torpedo tubes (the torpedo outfit of the Vittorio Emanuele); the water-line protected

by a complete belt 9 inches in thickness, tapering to 4 inches at the end (as in the Vermont and Katori), surmounted by an upper belt of 7.9 inches in thickness covering about one-half the length of the vessel (as in the Vittorio Emanuele) the 12-inch guns protected by 8-inch armor on turrets and armored tubes (as in the Vittorio Emanuele); and the 6.7 inch guns protected by 6-inch armor (as in the Katori). It will be assumed that the protection secured by the protective decks, conning tower, etc., in the several designs is so nearly uniform that they may be neglected in the comparison being made.

For naval purposes the value of a vessel is determined chiefly by the battery and ammunition carried, the protection given to the guns, personnel and stability, the coal carried as affecting the time during which a vessel may operate without coaling and the speed. As pointed out in the paper mentioned above, this value is independent of the displacement; although there is a relation between displacement and the naval value attainable, which fixes the limit of naval value

for any displacement, and the excellence of a design should be judged by the nearness of the approach of the design to this limiting condition. It has been assumed that the naval value of the type design may be presented by the figure 5100, this being estimated weight which in the design, would be applied to the development of the purely naval features.

The designers of the several vessels under consideration, having provided for the minima for the several essential features of battleship design, have varied the distribution of the remaining disposable weight in a manner dictated by their ideas as to the best distribution, the naval policy of the country, or other reasons. The one restricting and governing condition in the development of these features in a design is weight; and in considering a design from a point of view of the naval architect and builder, its value can be expressed in terms of the weight devoted to the purely naval features of the design. If, then, each of the vessels under consideration be compared with the type design, and estimate made of the weight required to develop from the type design in succession vessels embodying the several features of each of the vessels under consideration: there would be obtained figures which, when added to the naval value of the type design, would express numerically the value of each of the vessels being considered. The figures employed for estimating the armament in the present comparison, will include the ammunition, supports, etc., and it may here be stated that the figures used in the comparison made in the paper mentioned above did not adequately provide for ammunition, supports and other weights incident to the armament. This fact, taken in connection with the unfortunate choice of a type design magnifying the speed feature, places the present comparison on a somewhat different basis from that of the paper in question. For the purpose of this comparison armor in way of a deck which might be called the gun deck, whether guns are mounted on this deck or not, has been treated as armor for the protection of the intermediate caliber guns.

If, having derived values for the several designs numerically in the manner outlined; the figures for estimated total cost, exclusive of stores, etc., for each of the vessels, as given in Table II. above, be divided by the corresponding figures expressing the relative naval value of the vessel; there will be obtained figures representing the relative cost

in dollars per unit of naval value. These figures represent roughly the relative efficiency of the designs from the point of view of cost.

On the other hand, since the figures for relative naval values are expressed in terms of the same dimensions, mathematically, as the displacements, division of the figures for relative naval value for each of the vessels by the displacement of the vessel will give figures which, when expressed as percentages, may be taken as roughly representing the relative efficiencies of the several designs from the designer's point of view.

The several vessels when compared with the type design, show increases in the several features going to make up naval values, with corresponding numerical additions to this value, derived relative naval values, design efficiency and costs per unit of naval value as follows:

VERMONT.	
Two additional 12-inch guns.....	Value 380
Eight additional 8-inch guns.....	" 509
Twelve 7-inch guns instead of fourteen 6.7-inch guns	" —25
Additional secondary battery.....	" 90
Two additional submerged torpedo tubes.....	" 30
Additional protection for 12-inch guns.....	" 570
Protection for 8-inch guns.....	" 450
Additional protection for 7-inch guns.....	" 25
Large area, 7-inch upper belt.....	" 220
Additional coal supply on designed displacement..	" 200
For the same speed the addition of the above weights requires increase in machinery....	" 150
Total additional value.....	2,680
Value of type design.....	5,100
Relative naval value.....	7,780
Displacement	16,000
Efficiency of design.....	48.6
Estimated total cost exclusive of stores, etc.....	\$7,118,000
Cost per unit, naval value.....	\$915

LORD NELSON.	
Two additional 12-inch guns.....	Value 380
Ten 9.2-inch guns, in place of fourteen 6.7-inch guns	" 350
Additional secondary battery.....	" 90
Two additional submerged torpedo tubes.....	" 30
Additional protection for 12-inch guns.....	" 620
Additional protection to the intermediate caliber guns	" 500
Additional water line protection.....	" 230
Additional upper belt protection.....	" 310
Additional coal provided for on design displacement	" 200
With weights added above to maintain a speed of 18 knots necessitates additional machinery weights	" 175
Total additional value.....	2,885

Value of type design.....	5,100
Naval value relative to type design.....	7,985
Displacement	16,500
Efficiency of design.....	48.4
Estimated total cost exclusive of stores, etc.....	\$7,329,000
Cost per unit, naval value.....	\$918

KATORI.	
Two additional 12-inch guns.....	Value 380
Four additional 10-inch guns.....	" 550
Twelve 6-inch guns in place of fourteen 6.7-inch guns	" —80
Three additional submerged torpedo tubes.....	" 45
Additional protection for 12-inch guns.....	" 570
Protection for 10-inch guns.....	" 500
Additional upper belt protection.....	" 150
Additional coal provided for on design of displacement	" 50
For one-half knot more speed, considering additional weights above, necessitates increase in machinery weights.....	" 250
Total additional value.....	2,415
Value of type design.....	5,100
Naval value relative to type design.....	7,515
Displacement	15,950
Efficiency of design.....	47.2
Estimated total cost exclusive of ammunition, stores, etc.....	\$6,851,000
Cost per unit, naval value.....	\$912

DEMOCRATIE.	
Two additional 12-inch guns.....	Value 380
Ten 7.6-inch guns in place of fourteen 6.7-inch guns	" 150
Additional secondary battery.....	" 30
Three additional above water torpedo outfits..	" 20
Additional protection for 12-inch guns.....	" 390
Additional protection for 7.6-inch guns	" 330
Extra water-line protection.....	" 80
Longer and narrower upper belt.....	" 200
Additional coal provided for in design displacement	" 205
For the same speed the addition of weights above necessitates increase in machinery weights..	" 110
Total additional value.....	1,805
Value to type design.....	5,100
Naval value relative to type design.....	6,905
Displacement	14,615
Efficiency of design.....	47.07
Estimated total cost exclusive of ammunition, stores, etc.....	\$6,515,000
Cost per unit, naval value.....	\$932

VITTORIO EMANUELE.	
Twelve 8-inch guns in place of fourteen 6.7-inch guns	Value 380
Additional secondary battery.....	" 30
Additional protection for 8-inch guns.....	" 25
Additional coal on design displacement.....	" 300

TABLE III.—Table of Relative, Additional and Total Naval Values, Costs and Efficiencies.

	Lord Nelson.		Vermont.		Katori.		Democratie.		Vittorio Emanuele.		Deutschland.	
	Added value.	Totals.	Added value.	Totals.	Added value.	Totals.	Added value.	Totals.	Added value.	Totals.	Added value.	Totals.
Heavy guns and ammunition.....	380		880		380		380		—		245	
7.6" to 10" guns, inclusive.....	350		590		550		150		380		—	
6" to 7" guns.....	—		—25		—80		—		—		—	
Secondary battery.....	90		90		90		30		30		90	
Torpedo outfit.....	30		30		45		20		—		60	
Total Armament.....	850		1,065		895		580		410		395	
Protection for largest caliber guns.....	620		570		570		390		—		420	
Protection for intermediate caliber guns.....	500		475		500		330		25		—	
Water-line protection.....	230		—		—		80		—		30	
Upper belt.....	310		220		150		200		—		240	
Total protection.....	1,660		1,265		1,220		1,000		25		690	
Coal supply.....	200		200		50		205		300		—	
Machinery.....	175		150		250		110		500		50	
Total additional value.....	2,885		2,680		2,415		1,895		1,235		1,135	
Value of type design.....	5,100		5,100		5,100		5,100		5,100		5,100	
Relative naval value.....	7,985		7,780		7,515		6,995		6,335		6,235	
Estimated cost, excluding stores, ammunition, etc.....	\$7,329,000		\$7,118,000		\$6,851,000		\$6,515,000		\$5,439,000		\$5,871,000	
Cost per unit, naval value.....	\$918		\$915		\$912		\$932		\$859.00		\$941.00	
Designed displacement.....	16,500		16,000		15,950		14,635		12,625		13,000	
Efficiency of design.....	48.4		48.6		47.2		47.7		50.2		48.0	

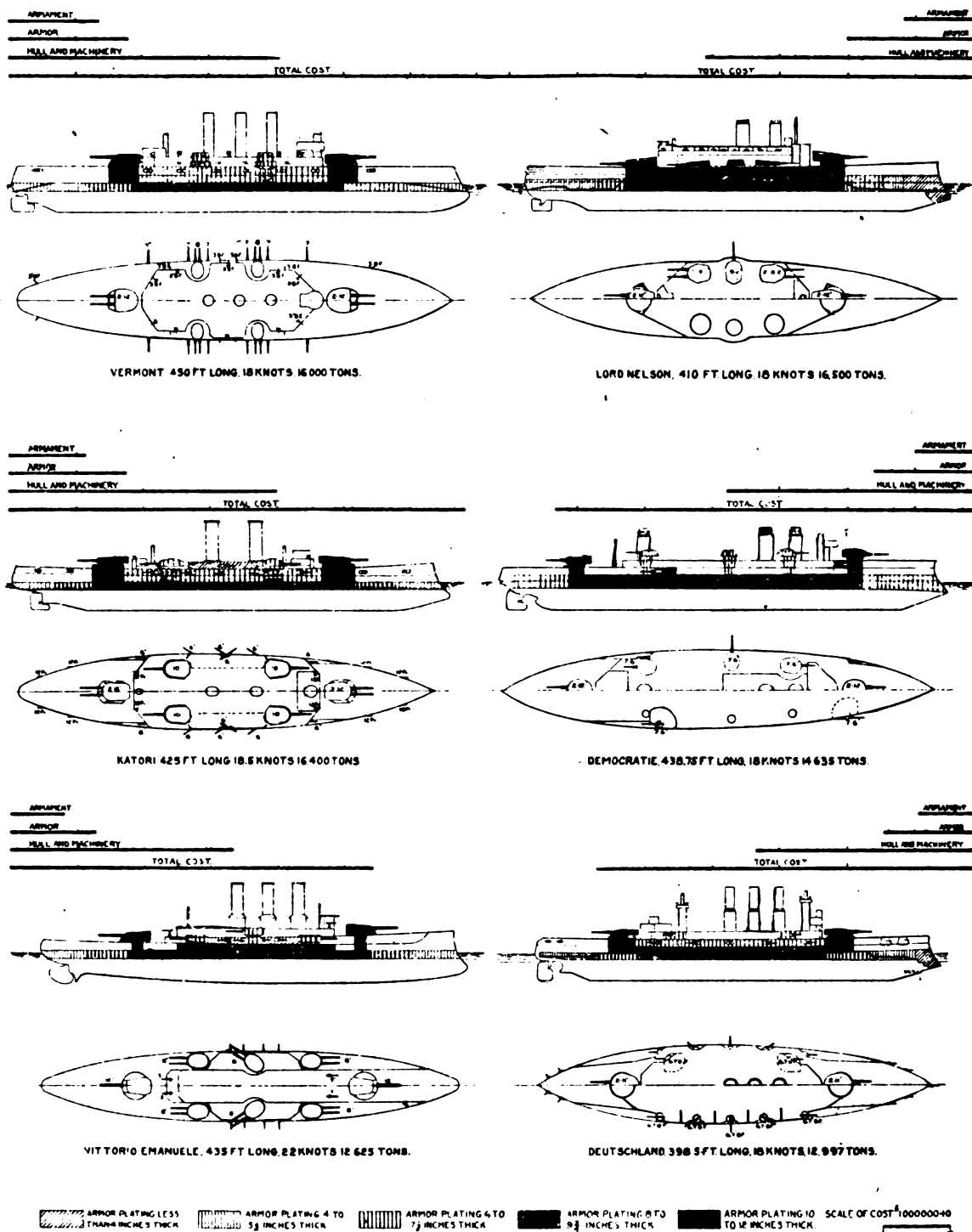


DIAGRAM COMPARING RECENT BATTLESHIP DESIGN.

Extra speed with increase in weight above necessitates increase in machinery weights.....

" 500

Total additional value.....	1,235
Value of type design.....	5,100
Naval value relative to type design.....	6,335
Displacement.....	12,625
Efficiency of design.....	50.2
Estimated total cost, exclusive of ammunition, stores, etc.....	\$5,439,000
Cost per unit, naval value.....	\$859

DEUTSCHLAND.

Four 11-inch guns in place of two 12-inch guns.....	Value 245
Additional secondary battery.....	" 90
Four additional submerged torpedo tubes.....	" 60
Additional protection for 11-inch guns.....	" 420
Additional water-line protection.....	" 30
Greater area of upper belt.....	" 240

For the same speed the addition of the above weights necessitates increase in machinery.

" 50

Total additional value.....	1,135
Value of type design.....	5,100
Naval value relative to type design.....	6,235
Displacement.....	13,000
Efficiency of design.....	48.0
Estimated total cost, exclusive of ammunition, stores, etc.....	\$5,871,000
Cost per unit, naval value.....	\$941

In Table III there are given for each of the vessels in order of their relative naval value, the figures assigned to each of the several items, the estimated total cost, the cost per unit of naval value and the figures for percentage of displacement representing the efficiencies of the designs in parallel columns to facilitate direct comparison.

In next week's issue of the *Review* will be given the discussion of the turbine papers.

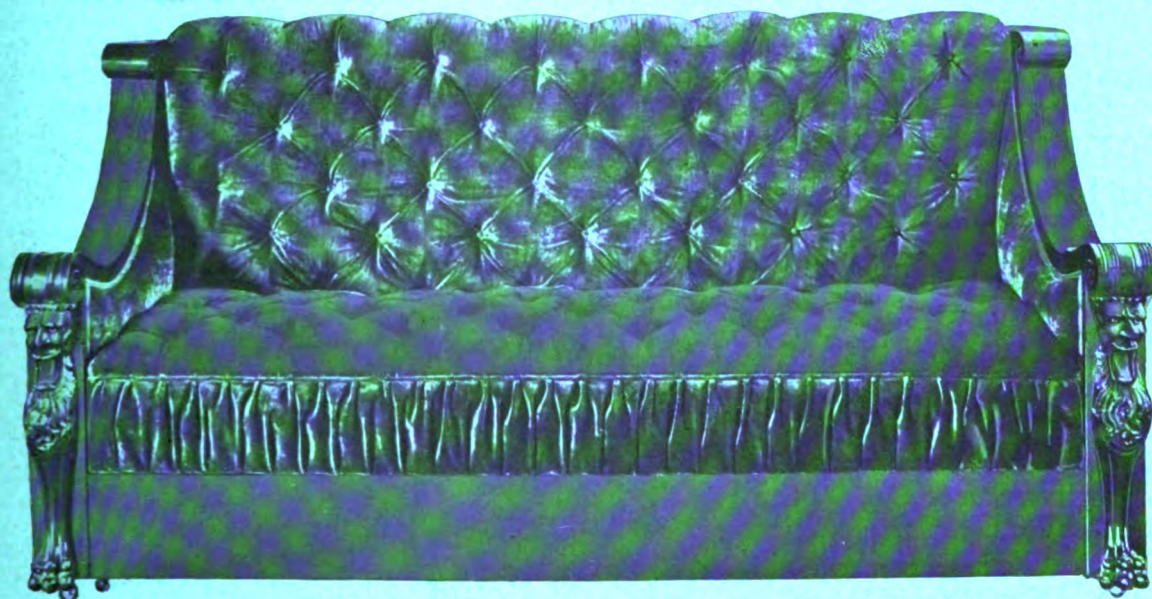


VOL. XXXII.

CLEVELAND, NOVEMBER 30, 1905.

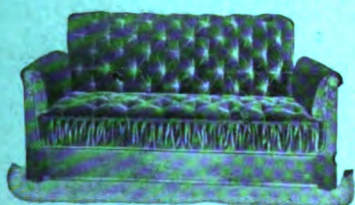
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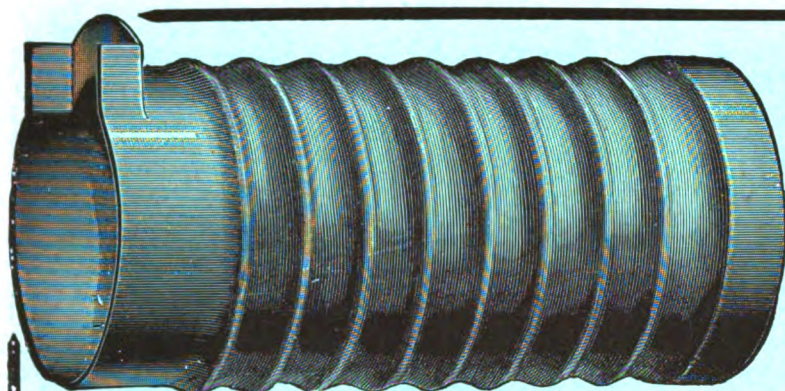


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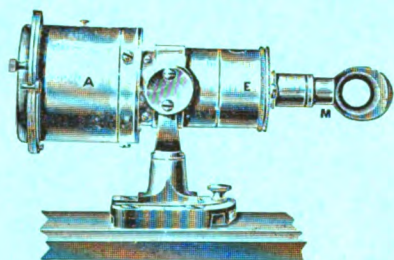
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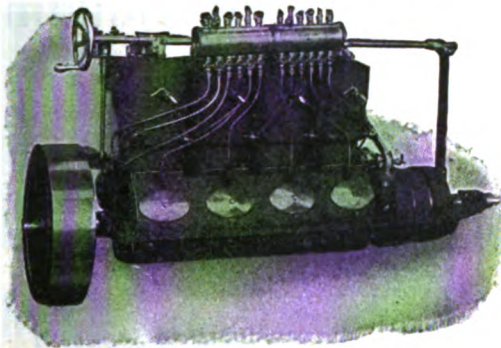


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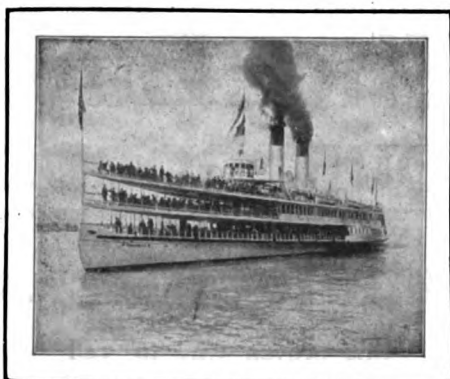
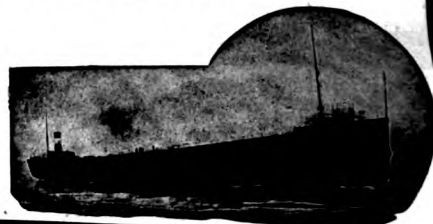
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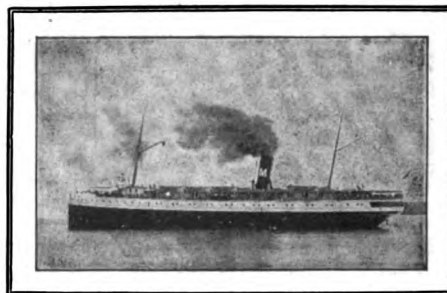
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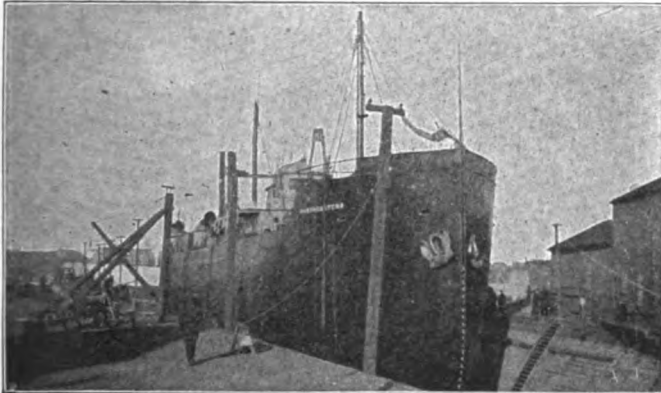
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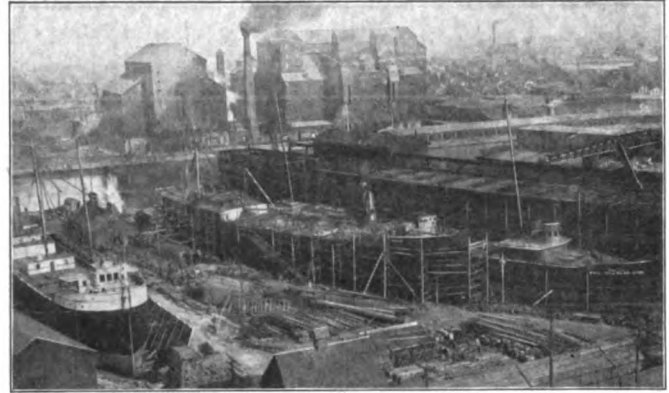
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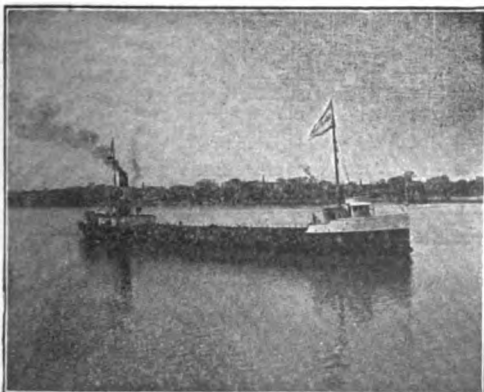
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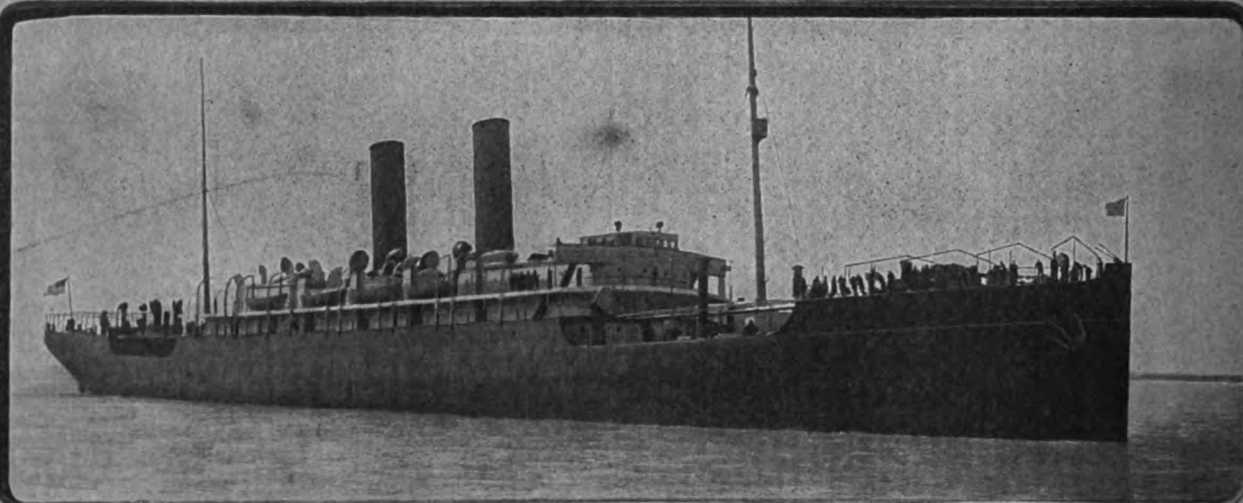
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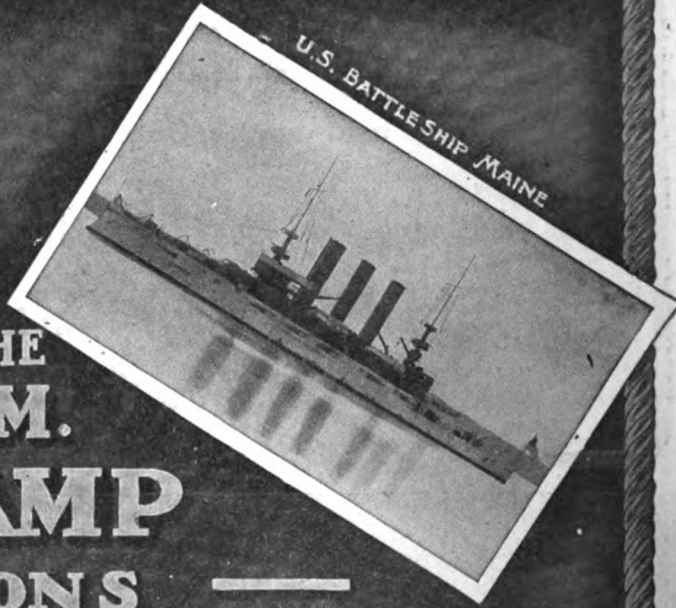
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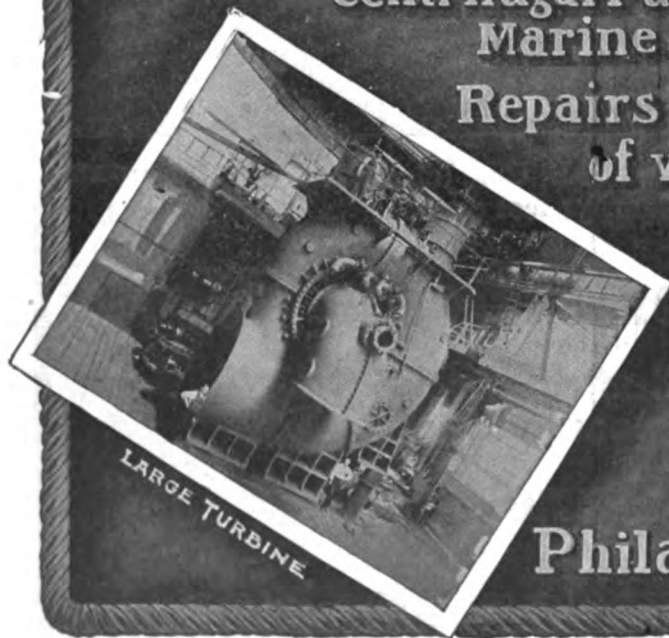
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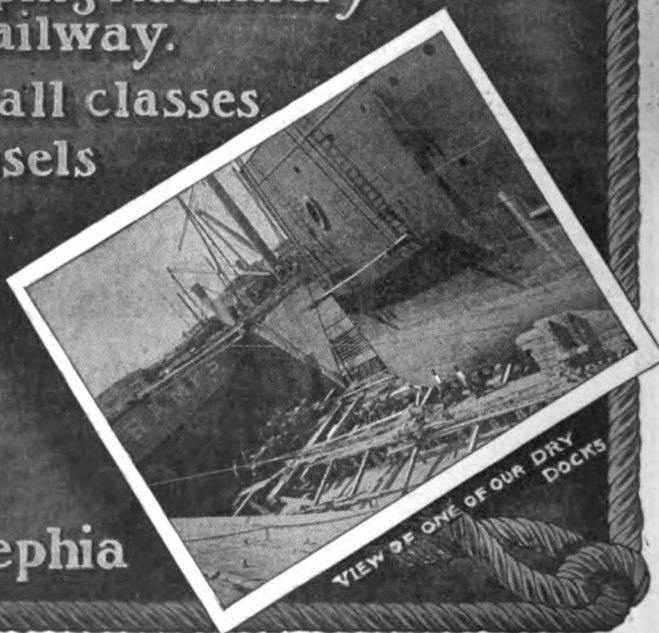
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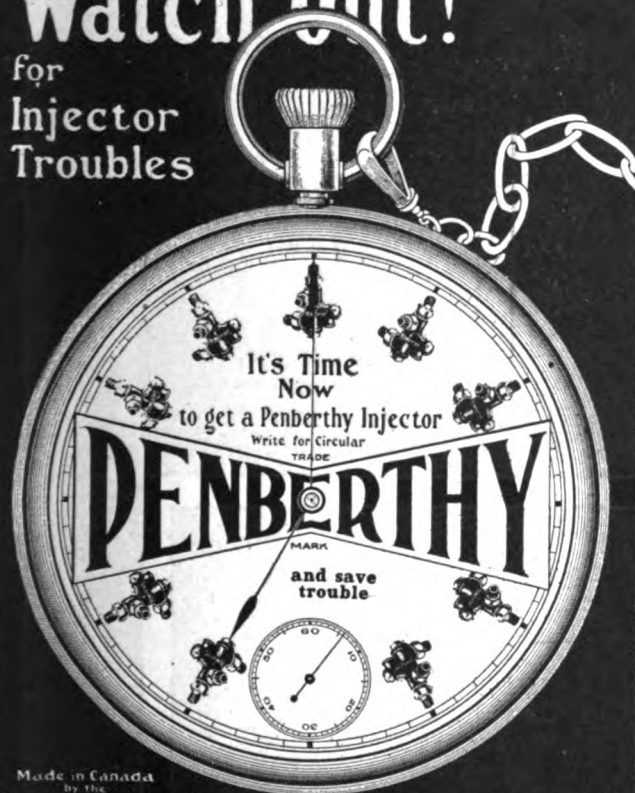
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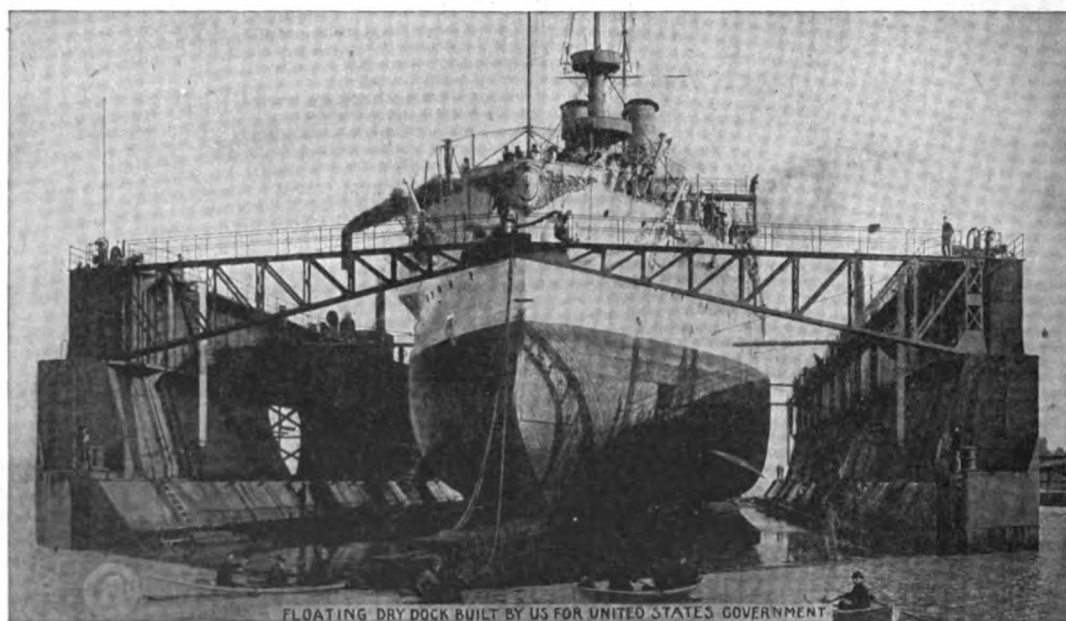
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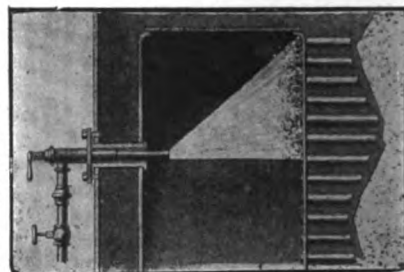
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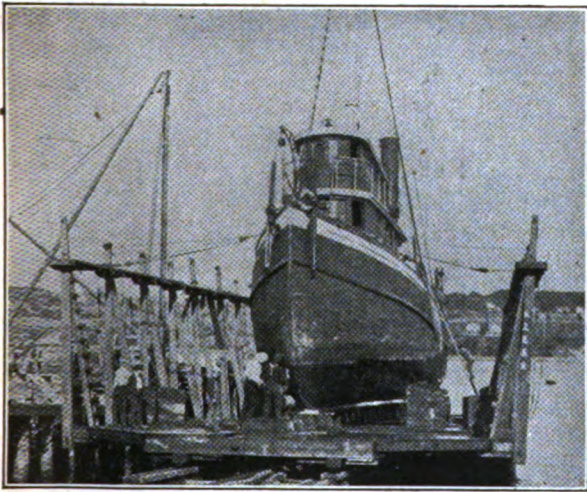
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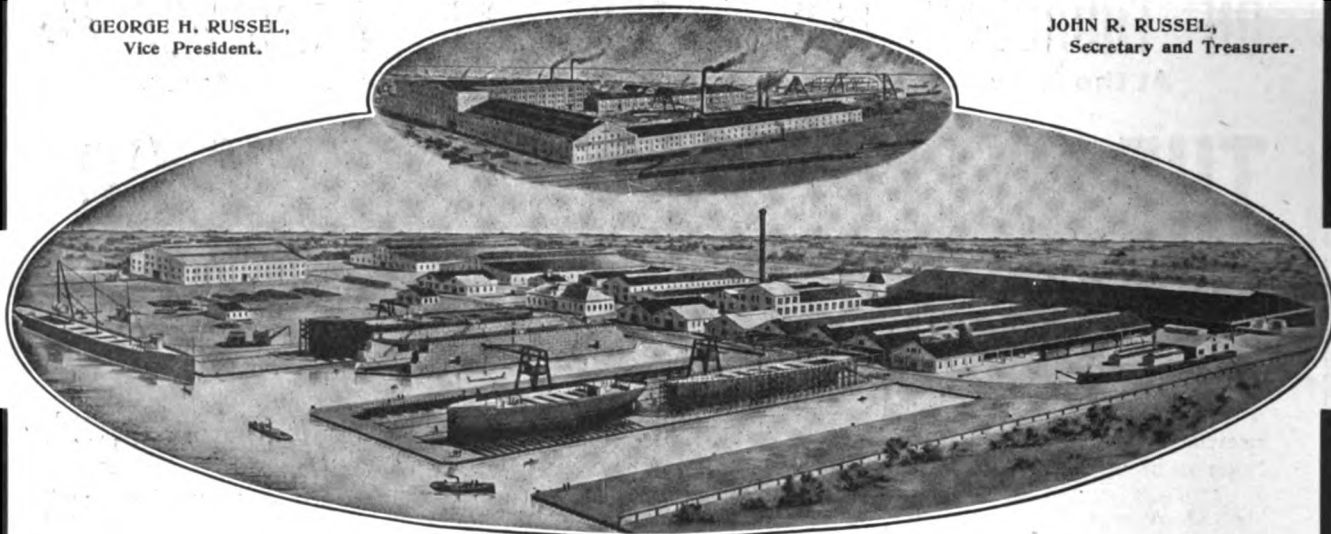
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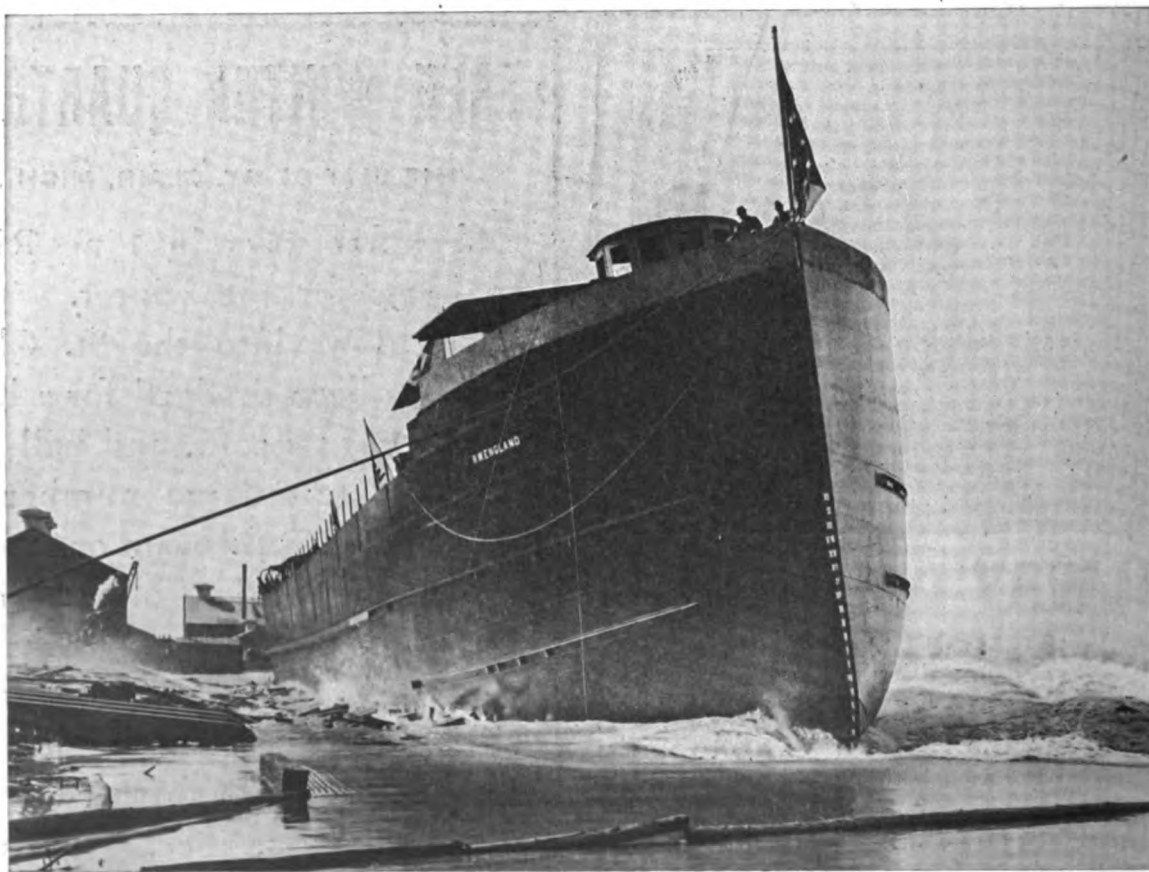
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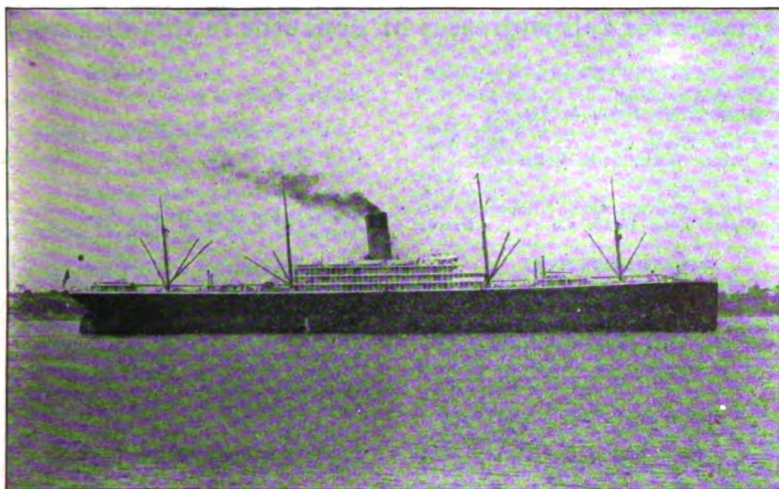


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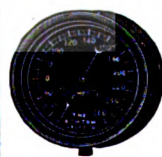
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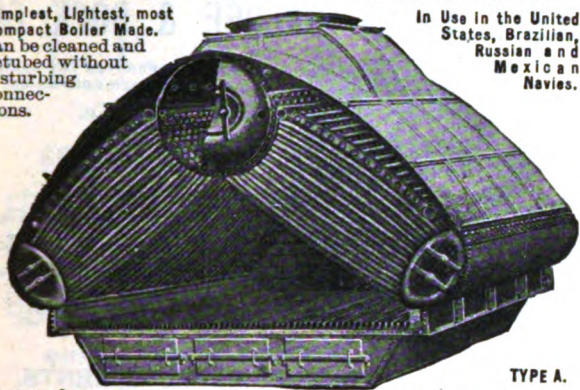
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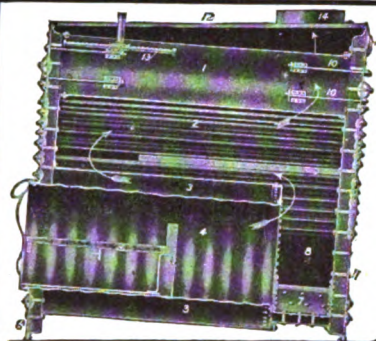
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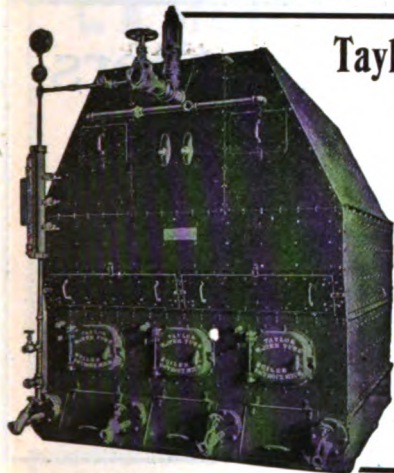
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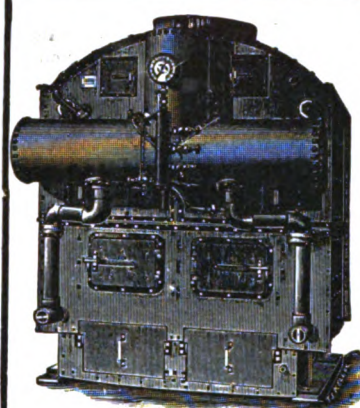
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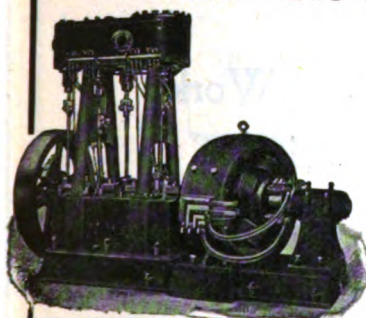
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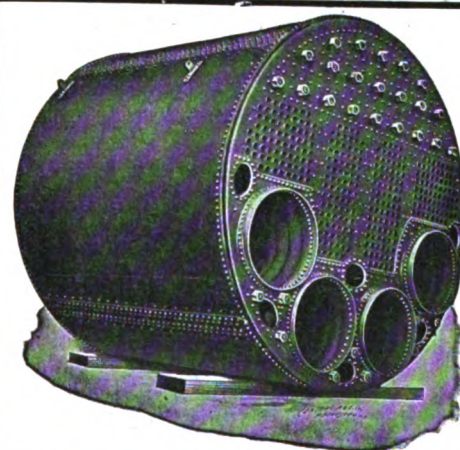
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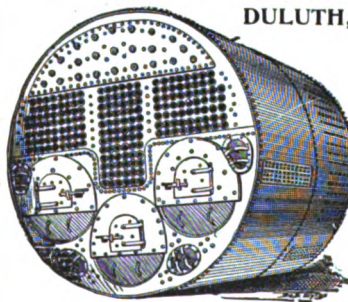
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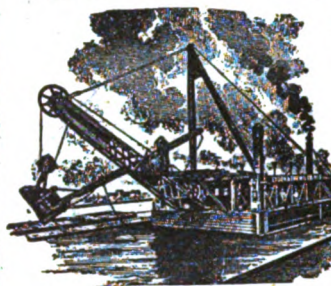
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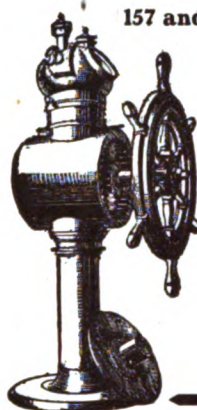


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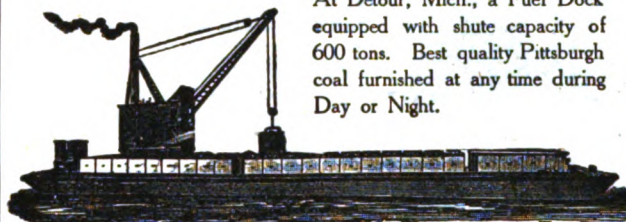
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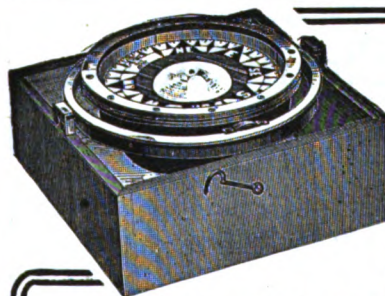
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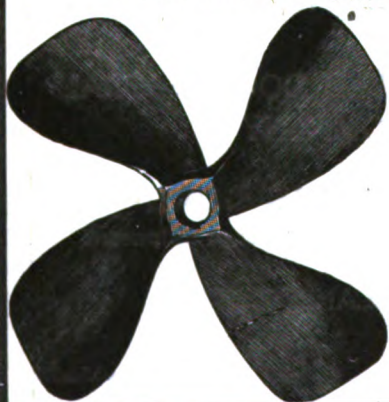
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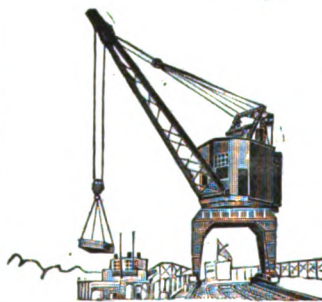
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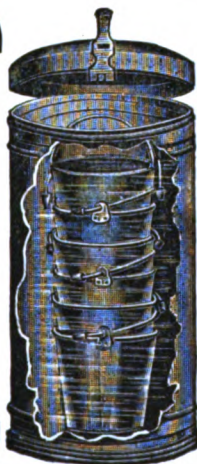
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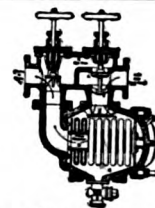
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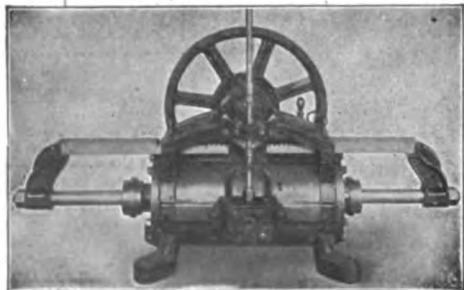
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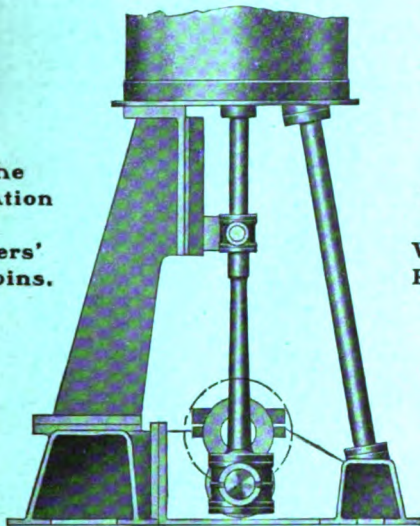
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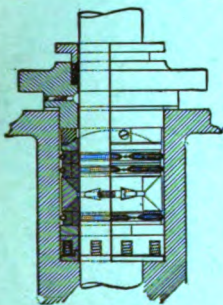
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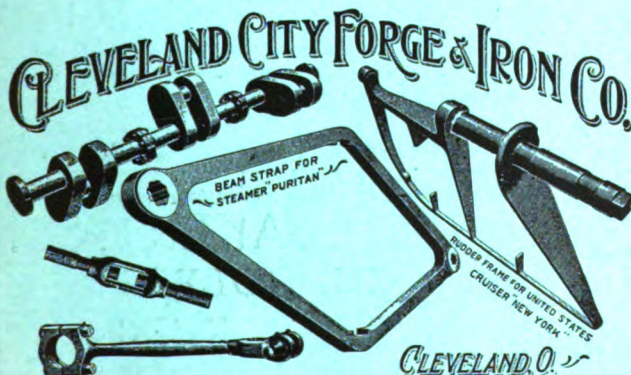
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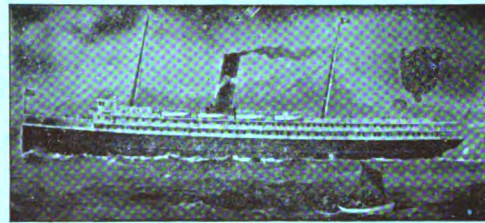
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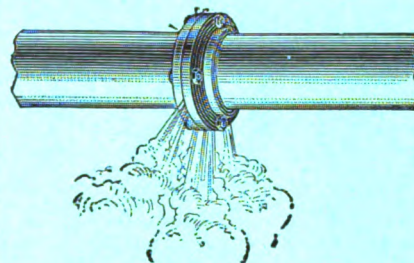
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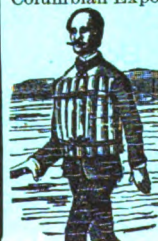
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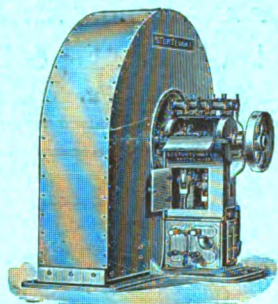
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